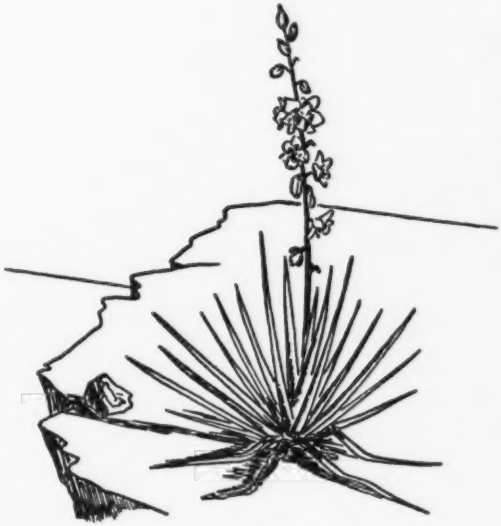
THE SOUTHWESTERN NATURALIST



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THE SOUTHWESTERN NATURALIST 2 (1): 1—18 JANUARY, 1957

THE ODONATA OF OKLAHOMA

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ABSTRACT. One hundred twenty-six species in 48 genera are recorded, 16 species new to the state list. Nineteen species previously recorded are of doubtful validity. Oklahoma and continental distribution are summarized and are correlated with physiography, climate, and vegetation. Fifty-two percent of the species are Eastern, 19 percent Transcontinental, 13 percent Western, and none are restricted to Oklahoma. Forty percent of all species cross the state in an east or west direction. Fifty-three percent are restricted in an east or west direction, 40 percent to eastern Oklahoma, 13 percent to western Oklahoma. Only eight percent are restricted in a north or south direction. Distribution within the state is correlated with the east-west precipitation gradient, not with the north-south temperature gradient. The central portion of the state, including 16 counties between Kay and Marshall, is an area of overlap for eastern and western species.

The earliest Oklahoma odonate records are by Williamson (1908, 1912a, 1912b, 1914) from Le Flore and Okmulgee Counties; in 1914 he lists 38 species. Ortenburger (1926) lists 21 species from southeastern Oklahoma. The only broad coverage of the state is that of Bird (1932) who gives county records for 106 species. Bird (1933) and Pritchard (1935, 1936), in addition to describing new species, mention important records from the southeastern part of the state. Bick (1951) lists species from Muskogee County. Needham and Westfall (1955) record 65 species of Anisoptera from Oklahoma.

We spent the summers of 1950 and 1951 at the Oklahoma A&M Wildlife Conservation Station in Muskogee County and the summers of 1954, 1955, and 1956 at the University of Oklahoma Biological Station in Marshall County. During these five summers we collected intensively in these counties and in adjoining ones, and in 1956 also in many western counties between Greer and Hughes, Osage and Marshall. Specimens were studied at the University of Oklahoma which included post publication collections of Bird, and at Oklahoma A&M which included post publication collections of Pritchard. This field and museum work demonstrated a need for a revision of Bird's (1932) list.

This paper summarizes distribution in Oklahoma and in America of 126 species and attempts to correlate these patterns with physiography, climate, and vegetation. Sixteen species are new to the state list and 19, previously recorded, are of doubtful validity.

LIST OF SPECIES

Oklahoma distribution for most species is by county. More specific localities are included for species recorded from the state for the first time (indicated by an asterisk) and for other infrequent species. Literature records are given first, followed by new county records. Counties previously listed in the literature are not repeated although there may have been additional material from the county. The abbreviations OU, OUBS, OAM refer to the University of Oklahoma, University of Oklahoma Biological Station, and Oklahoma Agricultural and Mechanical College respectively. When no abbreviation follows the list of counties, specimens were collected by me or by friends and are in my personal collection.

PETALURIDAE

*1. TACHOPTERYX THOREYI (Hagen). Muskogee: Braggs, 23 June 1951, 1♀.

CORDULEGASTERIDAE

2. CORDULEGASTER OBLIQUUS Say. Le Flore, Pushmataha (Pritchard, 1936).—Craig (OAM). A male (OU) from Latimer, determined as *Macromia annulata* by Bird and probably the basis for his 1932 record of *annulata* from Latimer, is *C. obliquus*.

GOMPHIDAE

3. PROGOMPHUS OBSCURUS (Rambur). Alfalfa, Beckham, Canadian, Cleveland, Comanche, Cotton, Greer, Hughes, Kiowa, Latimer, Love, Major, Oklahoma, Pontotoc, Pushmataha, Tillman, Woods (Bird, 1932). Muskogee (Bick, 1951).—Cimarron, Dewey, Kay, Texas (OAM). Harper (OAM, GHB). Beaver, Custer, Johnston, Marshall. This widely distributed species has been recorded from all counties in the Panhandle.

*4. GOMPHOIDES STIGMATUS (Say). Comanche: Wichita National Wildlife Refuge, 19 July 1954, 1 ♂. This species has hitherto been recorded only from Texas.

5. HAGENIUS BREVISTYLUS Selys. Le Flore (Williamson, 1914). Delaware, Latimer, McCurtain (Bird, 1932). Muskogee (Bick, 1951).—Johnston.

6. ERPETOGOMPHUS DESIGNATUS Hagen. Comanche, Major (Bird, 1932). Muskogee (Bick, 1951).—Cotton, Kiowa (OU). Marshall, Murray (OUBS, GHB). Bryan, Johnston, McCurtain.

7. DROMOGOMPHUS SPINOSUS Selys. Le Flore (Williamson, 1914; Bird, 1932). Haskell, Latimer (Bird, 1932). Muskogee (Bick, 1951).—Bryan, Choctaw, Mayes, Sequoyah (OAM). Johnston, McCurtain, Murray.

8. DROMOGOMPHUS SPOLIATUS (Hagen). Comanche, Latimer, McClain, Oklahoma (Bird, 1932). Muskogee (Bick, 1951).—Choctaw (OAM). Marshall (OUBS, GHB). Payne (OAM, GHB). Carter.

D. spoliatus, unlike *spinosus*, was not collected in several of the well studied southeastern counties and was more frequent in central Oklahoma. Most collections

of *spoliatus* were near lakes or ponds and not along wooded streams where *spinosus* was most frequent.

9. GOMPHUS (ARIGOMPHUS) LENTULUS Needham. Johnston, Love (Bird, 1932, as *subapicalis* Williamson).—Cleveland, Hughes, Latimer (OU).

10. GOMPHUS (ARIGOMPHUS) SUBMEDIANUS Williamson. Le Flore (Williamson, 1914). Hughes, Oklahoma (Bird, 1932).—Comanche, Cotton (OU). Carter, Marshall.

11. GOMPHUS (GOMPHURUS) EXTERNUS Hagen. Alfalfa, Caddo, Cleveland, Jackson, Murray, Pottawatomie (Bird, 1932). Muskogee (Bick, 1951).—Johnston, Marshall, McCurtain, Rogers, Wagoner.

12. GOMPHUS (GOMPHUS) GRASLINELLUS Walsh. Le Flore (Williamson, 1914). Haskell, Murray, Oklahoma, Pushmataha (Bird, 1932). Latimer (Bird, 1932; Pritchard, 1935).—Delaware (OAM). McCurtain. These are apparently the southernmost records for this species.

13. GOMPHUS (GOMPHUS) MILITARIS Hagen. Alfalfa, Cleveland, Comanche, Johnston, Latimer, Love, McClain, Major, Mayes, Oklahoma, Woods (Bird, 1932). Muskogee (Bick, 1951).—Greer, Marshall, Murray, Washita, Woodward. *G. militaris* was widely distributed and was the most frequent species of the genus in Oklahoma.

14. GOMPHUS (GOMPHUS) OKLAHOMENSIS Pritchard. Latimer, McCurtain (Pritchard, 1935).

15. GOMPHUS (STYLURUS) PLAGIATUS Selys. Le Flore (Williamson, 1914).—Cotton, Kiowa (OU). Grady (OAM). Marshall.

AESHNIDAE[1]

16. BASIAESCHNA JANATA (Say). Beckham, Caddo, Cleveland, Comanche, Jackson, Johnston. Kiowa, Le Flore, Murray (Bird, 1932).—McCurtain.

17. BOYERIA VINOSA (Say). Pushmataha (Pritchard, 1936). Muskogee (Bick, 1951).—Johnston.

18. ANAX JUNIUS (Drury). Okmulgee (Williamson, 1914). Alfalfa, Caddo, Canadian, Carter, Cleveland, Comanche, Cotton, Garvin, Grady, Greer, Hughes, Johnston, Latimer, Le Flore, Love, McClain, McCurtain, Murray, Oklahoma, Pittsburg, Pontotoc, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Beaver, Cimarron, Harper, Osage, Payne, Texas, Woodward (OAM). Adair, Beckham, Marshall.

*19. ANAX LONGIPES Hagen. On June 29, 1956, a single individual flew over a pond at the Federal Fish Hatchery near Reagan in Johnston County. This sight record is apparently the westernmost record for the United States, but *longipes* is reported from Mexico.

20. NASIAESCHNA PENTACANTHA (Rambur). Cleveland, Comanche, Cotton, Latimer, Love, Major, Oklahoma, Pushmataha, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Craig, Ottowa, Payne, Pawnee, Sequoyah (OAM). Marshall.

21. EPIAESCHNA HEROS (Fabricius). Le Flore (Williamson, 1914). McCurtain (Ortenburger, 1926). Woods (Bird, 1932).—Payne (OAM).

[1] The spellings Aeshnidae and *Aeshna* are retained by the author, who follows Opinion 34 of the International Commission on Zoological Nomenclature. These are not consistent with those of compound names of allied genera using Greek prefixes and treating the original name as (Latinized) Greek, and are not in accord with statements and examples in the Rules regarding orthography. It is my considered opinion that the Commission did not study the matter adequately, and that its ruling on *Aeschna* (pronounced "Eesknus," not Eeshnus") should be reconsidered.—*Editor's note.*

22. AESHNA MULTICOLOR Hagen. Major (Bird, 1932). A single female (OU), taken in Major County on June 26, 1930 and determined as *multicolor* by Bird, was verified by the writer.

23. AESHNA UMBROSA Walker. Custer (Bird, 1932).—Cleveland, Murray (OU).

LIBELLULIDAE

24. DIDYMOPS TRANSVERSA (Say). Cleveland, Comanche, Johnston, Kiowa, Le Flore, Murray, Pittsburg (Bird, 1932). Latimer (Bird, 1932; Pritchard, 1936).—Mayes, Payne (OAM). McCurtain, Oklahoma.

25. MACROMIA GEORGINA (Selys). Le Flore (Williamson, 1909, 1914, as *australensis* Williamson). Latimer (Bird, 1932, as *australensis* Williamson). Four males from Haskell and Latimer Counties (OU), determined as *wabashensis* Williamson by Bird, were determined as *georgina* by the writer and by Dr. M. J. Westfall. These four specimens were probably the basis for the Bird (1932) record of *wabashensis* from these two counties.—Caddo, Cotton, Johnston, Kiowa (OU). Mayes (OAM). Marshall.

26. MACROMIA PACIFICA Hagen. Atoka, Comanche, Latimer, Pottawatomie (Bird, 1932). Muskogee (Bick, 1951).—Johnston, Murray.

27. NEUROCORDULIA MOLESTA (Walsh). Oklahoma (Needham and Westfall, 1955).—Bryan, Blue, Blue River, July 23, 1954,1 nymph. Wagoner, Okay, Verdigris River, July 3, 1950, 1 last instar exuvium.

28. NEUROCORDULIA OBSOLETA (Say). Muskogee (Bick, 1951).—Johnston: Milburn, Blue River, July 23, 1954, 1 nymph. McCurtain, Broken Bow, Mountain Fork River, June 8, 1955, 1 last instar exuvium. McCurtain: Smithville, Mountain Fork River, July 8, 1955, 2 nymphs. The writers collected only the nymphal stage of both *molesta* and *obsoleta* in Oklahoma.

29. NEUROCORDULIA VIRGINIENSIS Davis. McCurtain (Byers, 1937). Byers (1937, p. 22) states, "Since this paper was written I have received a communication from Mr. A. Earl Pritchard in which he states: 'You would undoubtedly be glad to know that *Neurocordulia virginiensis* occurs as far west as Oklahoma. A female was taken by John Stankavich on Deep Fork River above Broken Bow, Oklahoma, June 18, 1934. We were catching *Platycordulia* at the time. The specimen was compared with the type by Mr. Davis.' " This record from eastern Oklahoma is a considerable distance west of other states, Alabama, Florida, Georgia, Mississippi, Tennessee, Virginia, listed by Needham and Westfall (1955).

30. NEUROCORDULIA XANTHOSOMA (Williamson). Le Flore (Williamson, 1908; 1914). Pushmataha (Ortenburger, 1926; Bird, 1932; Pritchard, 1936). Latimer (Bird, 1932; Pritchard, 1936). Johnston, McCurtain, Sequoyah (Bird, 1932). Comanche (Byers, 1937). Muskogee (Bick, 1951).

31. EPICORDULIA PRINCEPS (Hagen). Cleveland, Comanche, Cotton, Kiowa, Latimer, Le Flore, Love, McClain, Oklahoma, Pushmataha (Bird, 1932). Muskogee (Bick, 1951).—Alfalfa, Choctaw, Mayes, Pawnee (OAM). Payne (OAM, GHB). Greer, Johnston, Marshall, McCurtain, Osage, Woods, Woodward.

32. TETRAGONEURIA CYNOSURA (Say). Beckham, Caddo, Cleveland, Comanche, Hughes, Latimer, Le Flore, McClain, McCurtain, Murray, Pittsburg, Pushmataha (Bird, 1932). Muskogee (Bick, 1951). Bird (1932) did not differentiate *cynosura* and *petechialis* and there is some doubt that *petechialis* is a distinct species. Specimens (OU) from Beckham, Murray, and Comanche Counties determined as *cynosura* by Bird were determined as *petechialis* by both the writer and Dr. E. J.

Kormondy. There are other specimens in the OU collection from Murray and Cleveland Counties which are definitely *cynosura;* some were undetermined by Bird, some were determined by him as *williamsoni* Muttkowski. Thus, of Bird's list of counties, I could verify material from only Cleveland and Murray.—Carter, Washita, Woodward.

*33 TETRAGONEURIA PETECHIALIS (Muttkowski). Beckham, Comanche, Murray (OU). Greer, Woodward. It is interesting to note that three males of *petechialis* and three of *cynosura* were collected by the authors at the same spot in Boiling Springs Park on June 2, 1956 and that there are specimens of the two species in the OU collection from Murray taken on May 14, 1932.

*34. TETRAGONEURIA SPINOSA (Hagen). A single male (OU) from Latimer determined as *canis* by Bird is probably the basis of his (1932) record of *canis* from Latimer. This specimen was determined as *spinosa* by both the writer and Dr. E. J. Kormondy.

35. TETRAGONEURIA WILLIAMSONI Muttowski. Le Flore (Muttowski, 1911; Williamson, 1914). Muttkowski's three type specimens and the Williamson record are from Wister.

*36. HELOCORDULIA UHLERI Selys. McCurtain: Hochatown, Mountain Fork River, April 12, 1956, 1 ♂, L. E. Hornuff. This is a considerable westward extension of the range of this eastern species, which Needham and Westfall (1955) record west to Kentucky, Tennessee, and Louisiana.

37. SOMATOCHLORA LINEARIS (Hagen). Latimer, Le Flore (Pritchard, 1936). Muskogee (Bick, 1951). One male (OU) from Latimer determined as *ensigera* by Bird and probably the basis for his (1932) record of *ensigera* from Latimer is *linearis.*—McCurtain (OAM, GHB). Marshall. These are the westernmost records for *linearis*, which Needham and Westfall (1955) report west to Missouri.

38. SOMATOCHLORA OZARKENSIS Bird. Latimer (Bird, 1933; Pritchard, 1936). Le Flore (Pritchard, 1936). Needham and Westfall (1955) record this species from only Missouri and Oklahoma.

39. SOMATOCHLORA TENEBROSA (Say). Latimer, Le Flore (Pritchard, 1936). These are the westernmost records for the species which Needham and Westfall (1955) record west to Iowa and Missouri.

40. PERITHEMIS TENERA (Say). Le Flore, Okmulgee (Williamson, 1914). McCurtain (Ortenburger, 1926). Alfalfa, Canadian, Cleveland, Comanche, Greer, Haskell, Johnston, Kiowa, Le Flore, Love, McClain, Major, Murray, Osage, Payne, Pittsburg, Sequoyah, Tillman, Washita (Bird, 1932, as *P. domitia* Drury). Muskogee (Bick, 1951). All of the numerous specimens which I examined are *tenera.*—Carter, Cherokee, Marshall, Woodward.

41. CELITHEMIS ELISA (Hagen). Latimer (Bird, 1932). Pittsburg (Pritchard, 1935). Muskogee (Bick, 1951).—Okmulgee (OAM). Osage, Wagoner.

42. CELITHEMIS EPONINA (Drury). McCurtain (Ortenburger, 1926). Love (Bird, 1932). Muskogee (Bick, 1951).—Alfalfa, Harper, Pittsburg, Pushmataha (OAM). Carter (OAM, GHB). Choctaw, Comanche, Johnston, Marshall. *C. eponina* crosses the state whereas other species of the genus are restricted to eastern Oklahoma.

43. CELITHEMIS FASCIATA Kirby. Choctaw (Ortenburger, 1926). Pittsburg (Pritchard, 1935). Muskogee (Bick, 1951). One male (OU) from Latimer determined as *monomelaena* Williamson by Bird and probably the basis for his (1932) record of *monomelaena* from Latimer, was determined as *fasciata* by the writer.—Murray.

44. CELITHEMIS VERNA Pritchard. Pittsburg, Pushmataha (Pritchard, 1935).

45. ORTHEMIS FERRUGINEA (Fabricius). Comanche, Garvin, Haskell, Hughes, Latimer, McClain, Oklahoma, Pittsburg, Pushmataha, Washita (Bird, 1932).—Cimarron, Harper (OAM). McCurtain (OAM, GHB). Love, Marshall.

46. LADONA DEPLANATA (Rambur). Pushmataha (Pritchard, 1935).

*47. LIBELLULA AURIPENNIS Burmeister. *Muskogee*, Braggs, July 10, 1951, 1 ♂.

48. LIBELLULA COMANCHE Calvert. Woods (Bird, 1932).—Beaver, Cimarron, Ellis (OAM). Comanche (OU, OAM, GHB). Alfalfa, Carter, Love, Marshall.

49. LIBELLULA CROCEIPENNIS Selys. Comanche, Greer, Murray (Bird, 1932).—Tillman (OAM). Marshall. In contrast with *comanche* which is widely distributed in western United States and in western Oklahoma, *croceipennis* is known only from Costa Rica to Oklahoma and is apparently more common in the southwestern counties of the state.

50. LIBELLULA CYANEA Fabricius. Le Flore (Williamson, 1908, 1914; Bird, 1932). Muskogee (Bick, 1951).—Craig, Mayes, McCurtain (OAM). This species was common in Muskogee but was not collected during three summers of intensive effort in Marshall County.

*51. LIBELLULA FLAVIDA Rambur. *Muskogee*, Braggs, July 22, 1951, 6 ♂, 3 ♀. Latimer, June 8, July 21, 23, 1931, 3 ♂, 4 ♀ (OU).

52. LIBELLULA INCESTA Hagen. Le Flore (Williamson, 1914; Ortenburger, 1926; Bird, 1932). McCurtain (Ortenburger, 1926). Pushmataha (Ortenburger, 1926; Bird, 1932). Latimer, Pittsburg (Bird, 1932). Muskogee (Bick, 1951).—Atoka, Haskell (OAM). Johnston, Marshall. This species was widely distributed in eastern Oklahoma but was never abundant.

53. LIBELLULA LUCTUOSA Burmeister. Le Flore (Williamson, 1914). McCurtain (Ortenburger, 1926). Alfalfa, Beckham, Blaine, Canadian, Cleveland, Comanche, Cotton, Greer, Harmon, Johnston, Latimer, Logan, Love, McClain, Major, Murray, Oklahoma, Pottawatomie, Wagoner, Woods (Bird, 1932). Pushmataha (Pritchard, 1935). Muskogee (Bick, 1951).—Bryan, Craig, Mayes, Sequoyah (OAM). Carter, Custer, Payne (OAM, GHB). Marshall (OUBS, GHB). Atoka, Washita, Woodward. *L. luctuosa* is one of the most frequent and widely distributed libellulines in Oklahoma but is not yet recorded from the Panhandle.

54. LIBELLULA PULCHELLA Drury. Le Flore, Okmulgee (Williamson, 1914). Alfalfa, Blaine, Canadian, Cleveland, Comanche, Garvin, Johnston, Latimer, McClain, Major, Murray, Oklahoma, Woods, Woodward (Bird, 1932).—Beaver, Cimarron, Craig, Delaware, Ellis, Grant, Harper, Kay, Osage, Pawnee, Texas (OAM). Grady (OU). McCurtain, Payne (OAM, GHB). Marshall.

55. LIBELLULA SATURATA Uhler. Needham and Westfall (1955). I examined a single male (OAM) taken at Kenton in Cimarron County on June 26, 1933.

*56. LIBELLULA SEMIFASCIATA Burmeister. Muskogee: Braggs, June 23, 1951, 1 ♂. This record and the one from Texas by Needham and Westfall (1955) are apparently the westernmost for the species.

57. LIBELLULA VIBRANS Fabricius. Le Flore (Williamson, 1914). Muskogee (Bick, 1951).—Pushmataha (OAM). McCurtain.

58. PLATHEMIS LYDIA Drury. Le Flore (Williamson, 1914; Ortenburger, 1926). Okmulgee (Williamson, 1914). Alfalfa, Blaine, Canadian, Cleveland, Comanche, Craig, Garvin, Grady, Greer, Haskell, Hughes, Kiowa, Latimer, Love, McClain, McCurtain, Major, Mayes, Murray, Oklahoma, Pittsburg, Pottawatomie,

Pushmataha, Washita, Woods, Woodward (Bird, 1932). Muskogee (Bick, 1951).—Beaver, Cimarron, Ellis, Harper, Kay, Ottawa, Texas, Washington (OAM). Caddo, Custer, Payne (OAM, GHB). Marshall (OUBS, GHB). Carter, Cherokee, Johnston. *P. lydia* was the most abundant and widely distributed odonate in Oklahoma. It occurred throughout the state including the three Panhandle counties.

59. PLATHEMIS SUBORNATA Hagen. Beaver: Beaver, July 26, 1933, 1♀, OAM. Cimarron: Kenton, July 7, 1933, 1♂, OAM. This western species is not reported east of the Panhandle.

60. ERYTHRODIPLAX CONNATA MINUSCULA (Rambur). Comanche (Bird, 1932).

61. ERYTHRODIPLAX UMBRATA (Linnaeus). Cleveland, Cotton, Latimer, McClain, Woods (Bird, 1932).—McCurtain.

62. SYMPETRUM AMBIGUUM (Rambur). Le Flore (Bird, 1932).—Alfalfa, Pittsburg, Pushmataha (OAM). Woods (OU). McCurtain (OAM, GHB). Kennedy (1917) states that *ambiguum* is probably confined to the eastern edge of Kansas. In Oklahoma, it was taken in northwestern as well as in southeastern counties.

*63. SYMPETRUM INTERNUM Montgomery. Cleveland, October 1950, 5♂, OU. *Payne*, Stillwater, October 8, 1950, 6♂, 5♀, GHB.

*64. SYMPETRUM OCCIDENTALE FASCIATUM Walker. Bird (1932) records *S. semicinctum* Say from Woods County but Walker (1951) states that records of *semicinctum* from Texas and Oklahoma probably refer to *fasciatum*. The writer examined two females (OU) from Woods which agree with Walker's (1951) description of *fasciatum*.

65. SYMPETRUM VICINUM (Hagen). Cleveland, Latimer, Le Flore (Bird, 1932).—Comanche, Harmon, Pawnee (OAM). Marshall, McCurtain, Murray, Muskogee.

66. TARNETRUM CORRUPTUM (Hagen). Okmulgee (Williamson, 1914). Alfalfa, Beckham, Blaine, Bryan, Caddo, Canadian, Cimarron, Cleveland, Comanche, Cotton, Grady, Jackson, Johnston, Kiowa, McClain, McCurtain, Major, Murray, Oklahoma, Stephens, Tillman, Woods (Bird, 1932). Muskogee (Bick, 1951).—Beaver, Ellis, Grant, Harper, Kay, Le Flore, Osage, Payne, Texas (OAM). Woodward (OAM, GHB). Custer, Marshall.

67. ERYTHEMIS SIMPLICICOLLIS (Say). Le Flore (Williamson, 1914). McCurtain (Ortenburger, 1926). Alfalfa, Beckham, Cleveland, Comanche, Greer, Harmon, Kiowa, Latimer, Logan, Love, McClain, Major, Murray, Oklahoma, Osage, Tillman, Wagoner, Woods (Bird, 1932). Muskogee (Bick, 1951).—Caddo, Payne (OAM). Carter, Custer (OAM, GHB). Johnston, Marshall (OUBS, GHB). Atoka, Woodward.

68. LEPTHEMIS VESICULOSA (Fabricius). McClain (Bird, 1932).—Alfalfa (OAM). Cleveland, Marshall, Woodward. *L. vesiculosa* is widespread in the tropics but in the United States Needham and Westfall (1955) record it from only Florida, Oklahoma, and Texas. Although infrequent, this species extends from Marshall on the Texas border to Alfalfa on the Kansas border; the latter is the northernmost record for the species.

*69. CANNACRIA GRAVIDA (Calvert). Carter: Ardmore, July 7, 1955, 2♂. *C. gravida* is widely distributed in coastal areas but the Needham and Westfall (1955) record from Nebraska and the present one from Oklahoma show that it occurs much farther inland than is often assumed.

70. PACHYDIPLAX LONGIPENNIS (Burmeister). Le Flore (Williamson, 1914; Bird, 1932). McCurtain (Ortenburger, 1926). Alfalfa, Caddo, Cleveland, Co-

manche, Harmon, Latimer, Logan, Love, McClain, Major, Murray, Oklahoma, Payne, Pittsburg, Pottawatomie, Pushmataha, Tulsa, Wagoner, Woods (Bird, 1932). Muskogee (Bick, 1951).—Beaver, Choctaw, Delaware, Ellis, Haskell, Okmulgee, Pawnee (OAM). Harper (OAM, GHB). Marshall (OUBS, GHB). Carter, Johnston, Osage, Woodward.

71. DYTHEMIS FUGAX Hagen. Blaine, Comanche, Murray, Oklahoma (Bird, 1932).—Custer (OAM). Marshall.

72. DYTHEMIS VELOX Hagen. McCurtain (Ortenburger, 1926). Comanche, Latimer, Murray, Pushmataha (Bird, 1932). Muskogee (Bick, 1951).—Choctaw, Le Flore, Pittsburg, Sequoyah (OAM). Marshall (OUBS, GHB). Atoka, Carter, Johnston, Love. Needham and Westfall (1955) record *fugax* only from New Mexico, Texas, and Oklahoma; in Oklahoma it occurred in western and central counties. In contrast, they record *velox* from the Antilles and southeastern states as well as from Mexico and southwestern states; in Oklahoma, *velox* occurred primarily in southeastern counties.

73. BRECHMORHOGA MENDAX (Hagen). Murray (Bird, 1932).—Cimarron, Comanche, Payne (OAM). Marshall (OUBS). Johnston. Needham and Westfall (1955) record this species from Mexico to California, Texas, and Oklahoma. Like most southwestern species, *mendax* occurred primarily in western Oklahoma and extended east only to Payne and Johnston Counties.

74. TRAMEA CAROLINA (Linnaeus). The only Oklahoma record (Bick, 1951) of this eastern species was based on a single early instar nymph. The presence of *carolina* in Oklahoma is now substantiated by a male which I examined (OAM) from Payne County collected on August 29, 1938.

75. TRAMEA LACERATA Hagen. McCurtain (Ortenburger, 1926). Alfalfa, Beckham, Caddo, Cleveland, Comanche, Garvin, Harmon, Hughes, Latimer, Le Flore, McClain, Murray, Oklahoma, Pittsburg, Woods (Bird, 1932). Muskogee (Bick, 1951).—Beaver, Ellis, Harper, Pawnee, Texas (OAM). Carter, Cherokee, Greer, Johnston, Love, Marshall, Osage, Woodward.

76. TRAMEA ONUSTA Hagen. McCurtain (Ortenburger, 1926). Alfalfa, Blaine, Caddo, Canadian, Cleveland, Comanche, Garvin, Harmon, Hughes, Latimer, Le Flore, McClain, Major, Murray, Oklahoma, Tillman, Washita, Woods (Bird, 1932). Pushmataha (Bird, 1932; Pritchard, 1935). Muskogee (Bick, 1951).—Beaver, Cimarron, Craig, Ellis, Harper, Haskell, Okmulgee, Pawnee, Payne, Pittsburg, Texas, Woodward (OAM). Greer, Marshall, Osage.

77. PANTALA FLAVESCENS (Fabricius). Okmulgee (Williamson, 1914). McCurtain (Ortenburger, 1926). Canadian, Cleveland, McClain, Major, Oklahoma, Pottawatomie, Woods (Bird, 1932).—Alfalfa, Cimarron, Ellis, Harper, Osage, Pawnee, Payne, Woodward (OAM). Comanche, Greer, Johnston, Marshall. This cosmopolitan species crossed the state but was neither as frequent nor as abundant as *P. hymenea*.

78. PANTALA HYMENEA (Say). Okmulgee (Williamson, 1914). Beckham, Blaine, Canadian, Cleveland, Comanche, Latimer, McClain, Major, Oklahoma, Pittsburg, Woods (Bird, 1932). Muskogee (Bick, 1951).—Cimarron, Craig, Ellis, McCurtain, Osage, Pawnee, Payne (OAM). Alfalfa, Harper (OAM, GHB). Marshall (OUBS, GHB). Johnston. *P. hymenea* was widely distributed and was the only odonate frequently observed in swarms.

AGRIONIDAE

79. AGRION MACULATUM Beauvois. McCurtain (Ortenburger, 1926; Bird, 1932). Adair, Cleveland, Comanche, Delaware, Murray, Oklahoma, Ottawa, Push-

mataha, Sequoyah, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Alfalfa, Choctaw, Craig, Ellis, Harper, Kay, Nowata, Osage, Pawnee, Payne, Pittsburg, Woodward (OAM). Caddo (OAM, GHB). Marshall (OUBS, GHB).

80. HETAERINA AMERICANA (Fabricius). Le Flore (Williamson, 1914). McCurtain (Ortenburger, 1926). Alfalfa, Caddo, Canadian, Cleveland, Comanche, Cotton, Custer, Harmon, Jackson, Johnston, McClain, Major, Murray, Sequoyah, Woods (Bird, 1932). Muskogee (Bick, 1951).—Marshall (OUBS, GHB). Beaver, Beckham, Garvin, Harper, Roger Mills, Washita.

81. HETAERINA TITIA (Drury). Le Flore (Williamson, 1912a, 1914). Murray (Bird, 1932, as *H. tricolor* Burmeister). Muskogee (Bick, 1951).—Bryan, Johnston. *H. americana* extends across the United States and crosses Oklahoma; *titia* occurs primarily in eastern United States and was restricted to a few counties in eastern Oklahoma.

LESTIDAE

82. ARCHILESTES GRANDIS Rambur. Cleveland, Comanche, Custer, Greer, Latimer, McClain, Murray, Potawatomie, Woods (Bird, 1932).—Marshall (OUBS, GHB). Nowata.

83. LESTES ALACER Hagen. Cleveland, Comanche, Cotton, Garvin, Grady, McClain, Oklahoma, Washita, Woods (Birds, 1932). The writers examined males (OU) from the above counties except Cotton, Oklahoma, and Woods.

84. LESTES DISJUNCTUS AUSTRALIS Walker. McClain, Woods (Walker, 1952). Bird (1932) records *L. forcipatus* Rambur from Caddo, Canadian, Carter, Cleveland, Comanche, Cotton, Garvin, Grady, Hughes, Kay, Kiowa, Latimer, McClain, Oklahoma, Pittsburg, Pontotoc, Stephens, Washita, Woods. The writer examined 66 males and 29 females (OU) which Bird determined as *forcipatus* prior to Walker's (1952) description of *L. d. australis*. These specimens are from Caddo, Carter, Cleveland, Comanche, Hughes, McClain, Oklahoma, Washita, Woods and all are *L. d. australis*.—McCurtain.

85. LESTES DRYAS Kirby. Recorded from Oklahoma by Walker (1953).

86. LESTES INAEQUALIS Walsh. Le Flore (Williamson, 1914). Pushmataha (Bird, 1932; Pritchard, 1935).

87. LESTES RECTANGULARIS Say. Cleveland, Major, Woods (Bird, 1932).

88. LESTES UNGUICULATUS Hagen. Lincoln, McClain (Bird, 1932).

89. LESTES VIGILAX Hagen. Pushmataha (Pritchard, 1935).

COENAGRIONIDAE

*90. HYPONEURA LUGENS (Hagen). Cimarron: Kenton, June 29, 1933, 2♂, A. E. Pritchard (OAM).

91. ARGIA ALBERTA Kennedy. Alfalfa, McClain, Murray (Bird, 1932).—Comanche, Harmon, Woods (OU).

92. ARGIA APICALIS (Say). Le Flore (Williamson, 1914; Bird, 1932). Alfalfa, Atoka, Beckham, Blaine, Canadian, Cleveland, Comanche, Cotton, Craig, Delaware, Greer, Harmon, Haskell, Johnston, Kiowa, Latimer, McClain, McCurtain, Major, Mayes, Murray, Oklahoma, Pittsburg, Pottawatomie, Sequoyah, Tillman (Bird, 1932). Muskogee (Bick, 1951).—Adair (OAM). Marshall (OUBS, GHB). Beaver, Bryan, Carter, Custer, Harper, Osage, Wagoner. This eastern species occurred throughout the state and was the most frequent *Argia* in Oklahoma.

93. ARGIA BIPUNCTULATA (Hagen). Latimer (Bird, 1932).—Marshall, Muskogee.

94. ARGIA IMMUNDA (Hagen). Cleveland (Bird, 1932).—Comanche, Jackson, Latimer, Pushmataha (OU). Murray (OU, GHB). Garvin, Johnston, Marshall, Washita. *A. immunda*, recorded from only Mexico, Texas, and Oklahoma, was frequent and locally abundant in southern Oklahoma but are absent in the northernf half of the state.

95. ARGIA MOESTA (Hagen). Le Flore (Williamson, 1912b, 1914, as *intruda* Williamson and as *moesta* Hagen). McCurtain (Ortenburger, 1926, as *putrida* Hagen). Jackson, Latimer (Bird, 1932, as *intruda* Williamson). Adair, Cleveland, Comanche, Johnston, Love, McCurtain, Murray, Pushmataha (Bird, 1932, as *moesta* Hagen). Muskogee (Bick, 1951).—Marshall (OUBS, GHB). Bryan, Carter, Cherokee, Greer, Osage.

96. ARGIA AGRIOIDES NAHUANA Calvert. Bird (1932) reports *agrioides* Calvert from Cleveland, Comanche, Jackson, Latimer, Murray, Pushmataha, Wagoner. Specimens from Comanche (OU) labelled *agrioides* by Bird and so determined by Gloyd, were determined as subspecies *nahuana* by the writer. Numerous unidentified specimens (OU) from Cleveland are also *nahuana*. On the other hand, specimens (OU) determined by Bird as *agrioides*, from Cleveland, Jackson, Latimer, and Pushmataha are *immunda* (Hagen). We did not see specimens from Murray or Wagoner in the OU collection. We believe that all county records by Bird (1932) of *agrioides* pertain to subspecies *nahuana* but I was able to verify specimens from only Cleveland and Comanche.—Alfalfa, Beaver, Cleveland, Custer, Harper, Johnston, Love, Marshall, Murray, Woodward. Mrs. L. K. Gloyd (personal communication) believes that *nahuana* should be elevated to specific rank.

97. ARGIA VIVIDA PLANA Calvert. Cleveland, Comanche, Custer, Johnston, Latimer, Major, Murray, Pontotoc, Washita, Woods (Bird, 1932, as *vivida* Hagen). Muskogee (Bick, 1951.—Caddo (OAM, GHB). Marshall (OUBS, GHB). Blaine, Carter, Woodward. Mrs. L. K. Gloyd believes (personal communication) that *plana* should be elevated to specific rank.

98. ARGIA SEDULA (Hagen). McCurtain (Ortenburger, 1926). Alfalfa, Cleveland, Johnston, Major, Murray, Sequoyah, Woods (Bird, 1932).—Atoka, Carter, Custer, Greer, Marshall, Muskogee, Washita.

99. ARGIA TIBIALIS (Rambur). Le Flore (Williamson, 1914). Choctaw, McCurtain (Ortenburger, 1926). Atoka, Haskell, Latimer, Mayes, Murray, Pittsburg, Pushmataha, Sequoyah, Wagoner (Bird, 1932).—Bryan, Johnston.

100. ARGIA TRANSLATA Hagen. Johnston, Latimer, Murray (Bird, 1932). Muskogee (Bick, 1951).—Marshall, McCurtain.

101. ARGIA VIOLACEA (Hagen). Le Flore (Williamson, 1914; Ortenburger, 1926; Bird, 1932). McCurtain (Ortenburger, 1926). Alfalfa, Cleveland, Comanche, Cimarron, Greer, Johnston, Latimer, McClain, Murray, Oklahoma, Pushmataha, Wagoner, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Marshall (OUBS, GHB). Custer.

*102. AMPHIAGRION ABBREVIATUM (Selys). Two males (OU) collected in Cleveland County on April 4 and 10, 1932 and determined as *saucium* Burmeister by Bird are probably the basis for his 1932 record of *saucium* from Cleveland. Both of these males are *abbreviatum* Selys. There are three additional males and two females in the OU collection taken in Comanche County on July 8, 1932 and the writer collected five males and one female in Woodward County on June 23, 1956.

103. TELEBASIS SALVA (Hagen). Cleveland, Custer, McClain, Murray, Oklahoma (Bird, 1932).—Tillman (OAM). Love, Marshall.

104. NEHALLENIA INTEGRICOLLIS Calvert. Pushmataha (Pritchard, 1935). The only other records of this species are from New Jersey, Florida, and Louisiana.

105. ENALLAGMA ANTENNATUM (Say). Alfalfa (Bird, 1932). Three males and one female (OU) taken in Alfalfa County on June 15, 1930 were examined. These records from northwestern Oklahoma are probably the southernmost for this northeastern species.

106. ENALLAGMA ASPERSUM (Hagen). Latimer (Bird, 1932). Numerous males and females (OU) collected in Latimer County during June 1931 were examined.

107. ENALLAGMA BASIDENS Calvert. Alfalfa, Cleveland, Comanche, Jackson, Johnston, Latimer, Le Flore, McClain, Murray, Oklahoma, Tillman, Woods (Bird, 1932). Muskogee (Bick, 1951).—Marshall (OUBS, GHB). Carter, Greer, Osage, Washita, Woodward.

108. ENALLAGMA CARUNCULATUM Morse. Cimarron (Bird, 1932). A single male (OU) collected in Cimarron on July 27, 1930 was examined. This is apparently the southernmost record ofthis transcontinental but northern species.

109. ENALLAGMA CIVILE Hagen. Le Flore (Williamson, 1914; Bird, 1932). Okmulgee (Williamson, 1914). Alfalfa, Beckham, Caddo, Canadian, Cleveland, Cimarron, Comanche, Cotton, Garvin, Grady, Greer, Harmon, Hughes, Jackson, Kay, Kiowa, Latimer, McClain, McCurtain, Major, Murray, Oklahoma, Pittsburg, Pontotoc, Pottawatomie, Stephens, Tillman, Washita, Woods (Bird, 1932). Pushmataha (Pritchard, 1935). Muskogee (Bick, 1951).—Marshall (OUBS, GHB). Carter, Cherokee, Custer, Johnston, Love, Woodward.

110. ENALLAGMA DIVAGANS Selys. Le Flore (Williamson, 1914). Comanche, Latimer (Bird, 1932). Pushmataha (Bird, 1932; Pritchard, 1935). Comanche County is apparently the westernmost record for this widely distributed eastern species.

111. ENALLAGMA DUBIUM Root. Pushmataha (Pritchard, 1935). The westernmost record for this southeastern species.

112. ENALLAGMA EXSULANS (Hagen). Le Flore (Williamson, 1914). Cleveland, Haskell, Johnston, Murray, Pushmataha (Bird, 1932). Latimer (Bird, 1932; Pritchard, 1935). Muskogee (Bick, 1951).—Marshall, McClain, Osage.

113. ENALLAGMA GEMINATUM Kellicott. Le Flore (Williamson, 1914). Comanche, Murray (Bird, 1932).

114. ENALLAGMA PRAEVARUM (Hagen). Cimarron (Bird, 1932). Four males and one female (OU) collected in Cimarron County on June 27, 1930 were examined.

115. ENALLAGMA SIGNATUM (Hagen). Le Flore (Williamson, 1915). Cleveland, Comanche, Harmon, Latimer, McClain, Murray (Bird, 1932).—Johnston, Marshall, Muskogee, Woodward.

116. ENALLAGMA TRAVIATUM Selys. Le Flore (Williamson, 1914). —Latimer, June 18, 1932, 1 ♂, 1 ♀, OU; July 9, 1931, 1 ♀, OU.

117. ENALLAGMA VESPERUM Calvert. Williamson (1914) records *pollutum* Hagen from Le Flore and Bird (1932) gives this Williamson record under *laurenti* Calvert. Montgomery (1942) lists *vesperum* Calvert from Oklahoma. We could not find specimens of *laurenti-pollutum-vesperum* in the OU collection but judge that the above record pertains to *vesperum*.

118. TELEALLAGMA DAECKI (Calvert). Pushmataha (Pritchard, 1935). This is the westernmost record of this eastern species.

119. ISCHNURA BARBERI Currie. Alfalfa, Jackson, Woods, Woodward (Bird, 1932). We collected 13 males and 18 females at Ingersoll in Alfalfa County on June 5, 1956.

*120. ISCHNURA DEMORSA (Hagen) Woodward: Supply, 4 June 1956, 4♂, 9♀. Harper: May, 4 June 1956, 4♂, 4♀.

121. ISCHNURA DENTICOLLIS (Burmeister). Beckham, Oklahoma, Woods (Bird, 1932).—Woodward: Woodward, 2 and 4 June 1956, 5 ♂, 1 ♀.

The Oklahoma records for the above three species of *Ischnura* are probably the eastern limits for each, but *denticollis* extended farther eastward in Oklahoma than the others.

122. ISCHNURA KELLICOTTI Williamson. Le Flore (Williamson, 1908, 1914). Pushmataha (Pritchard, 1935).

123. ISCHNURA POSITA (Hagen). Le Flore (Williamson, 1914; Bird, 1932). Okmulgee (Williamson, 1914). Cleveland, Johnston, Latimer, McClain, McCurtain, Murray, Payne, Pittsburg, Pontotoc, Pushmataha, Sequoyah (Bird, 1932).—Carter, Marshall, Woodward.

*124. ISCHNURA RAMBURI (Selys). Muskogee: Braggs, 23 June 1951, 1♀. Marshall: Willis, 1 July 1954, 1 ♂. Carter: Ardmore, 7 July 1955, 1 ♂, 1 ♀.

125. ISCHNURA VERTICALIS (Say). Alfalfa, Caddo, Carter, Cleveland, Comanche, Cotton, Garvin, Harmon, Johnston, Kay, Latimer, Le Flore, Love, McClain, Murray, Oklahoma, Pittsburg, Pontotoc, Wagoner, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Custer, Marshall, Woodward.

126. ANOMALAGRION HASTATUM (Say). Le Flore (Williamson, 1914; Bird, 1932). Okmulgee (Williamson, 1914). Carter, Cleveland, Comanche, Cotton, Garvin, Harmon, Hughes, Latimer, McClain, Murray, Oklahoma, Pittsburg, Sequoyah, Washita, Woods (Bird, 1932). Muskogee (Bick, 1951).—Delaware (OAM). Johnston, Marshall, Woodward.

SYNONYMS AND DOUBTFUL RECORDS

Amphiagrion saucium Burmeister. See *abbreviatum*, no. 102.

Argia intruda Williamson. Synonym of *moesta*, no. 95.

Argia putrida Hagen. Synonym of *moesta* (Williamson, 1912b), no. 95.

Celithemis monomelaena Williamson. See *fasciata*, no. 43.

Enallagma laurenti Calvert. See *vesperum*, no. 117.

Enallagma pollutum Hagen. See *vesperum*, no. 117.

Enallagma piscinarum Williamson. Bird (1932) records this species from Latimer County. I could not find specimens of it in the OU collection. Montgomery (1942) states that records of *piscinarum* from Oklahoma are almost certainly in error.

Gomphus (Arigomphus) subapicalis Williamson. Synonym of *lentulus* (Gloyd, 1937), no. 9.

Hetaerina tricolor (Burmeister). Synonym of *titia* (Williamson, 1912a), no. 81.

Ischnura utahensis Muttkowski. Bird (1932) records this species from Alfalfa County but Needham and Heywood (1929) state that it is possibly a synonym of *barberi*.

Lestes forcipatus Rambur. See *disjunctus australis*, no. 84.

Libellula azilena Westwood. Ortenburger (1926) records this species from Latimer County. Bird (1932) states that this was based on a single female determined by Williamson with query. I doubt that the species occurs in Oklahoma.

Macromia annulata Hagen. See *Cordulegaster obliquus*, no. 2

Macromia australensis Williamson. Synonym of *georgiana* (Walker, 1937), no. 25.

Macromia wabashensis Williamson. See *georgiana*, no. 25.

Perithemis domitia Drury. See *tenera*, no. 40.
Somatochlora ensigera Martin. See *linearis*, no. 37.
Sympetrum semicinctum Say. See *occidentale fasciatum*, no. 64.
Tetragoneuria canis McLachlan. See *spinosa*, no. 34.

DISCUSSION

Continental distribution of each of the 126 species recorded from Oklahoma was determined primarily from Needham and Heywood (1929), Montgomery (1942, 1947, 1948), Walker (1953), and Needham and Westfall (1955). All but six species were placed in one of these categories: Eastern, Tropical and Eastern, Western, Tropical and Western, Transcontinental, Tropical and Transcontinental, Central.

Distribution within the state was determined by plotting all county records for each species on an individual map. The Oklahoma distribution of certain infrequent species was inferred from United States distribution as well as from Oklahoma records. Most eastern United States species were limited to eastern Oklahoma, *i.e.*, the area between the eastern border of the state and a north-south line at the western borders of Kay and Love Counties. Western United States species were limited to western Oklahoma, *i.e.*, the area between the western border of the state and a north-south line at the eastern borders of Kay and Marshall Counties.

In the following lists species are grouped according to distribution in America, and the range of each species in Oklahoma is given in parentheses using the abbreviations: E, eastern Oklahoma as defined above; W, western Oklahoma; C, crosses the state in an east or west direction (some are present in the Panhandle, others are not).

Eastern species (65, 52%) extend from the Atlantic Coast to a line from North Dakota south through Texas with very few records west of this line. A few included here occur in Mexico and many are recorded from Canada. Eastern species are: *Tachopteryx thoreyi* (E), *Cordulegaster obliquus* (E), *Progomphus obscurus* (C), *Hagenius brevistylus* (E), *Erpetogomphus designatus* (C), *Dromogomphus spinosus* (E), *D. spoliatus* (C), *Gomphus submedianus* (C), *G. plagiatus* (C), *Basiaeschna janata* (C), *Boyeria vinosa* (E), *Nasiaeschna pentacantha* (C), *Epiaeschna heros* (C), *Didymops transversa* (C), *Macromia georgina* (E), *Neurocordulia molesta* (E), *N. obsoleta* (E), *N. virginiensis* (E), *Epicordulia princeps* (C), *Tetragoneuria cynosura* (C), *T. spinosa* (E), *T. williamsoni* (E), *Helocordulia uhleri* (E), *Somatochlora linearis* (E), *S. tenebrosa* (E), *Perithemis tenera* (C), *Celithemis elisa* (E), *C. eponina* (C), *C. fasciata* (E), *C. verna* (E),

Ladona deplanata (E), *Libellula auripennis* (E), *L. cyanea* (E), *L. flavida* (E), *L. incesta* (E), *L. luctuosa* (C), *L. semifasciata* (E), *L. vibrans* (E), *Erythrodiplax c. minuscula* (C), *Sympetrum ambiguum* (C), *Cannacria gravida* (E), *Tramea carolina* (E), *Agrion maculatum* (C), *Lestes d. australis* (C), *L. inaequalis* (E), *L. rectangularis* (C), *L. vigilax* (E), *Argia apicalis* (C), *A. bipunctulata* (E), *A. tibialis* (C), *Nehalennia integricollis* (E), *Enallagma antennatum* (?), *E. aspersum* (E), *E. basidens* (C), *E. divagans* (E), *E. dubium* (E), *E. exsulans* (E), *E. geminatum* (E), *E. signatum* (C), *E. traviatum* (E), *E. vesperum* (E), *Teleallagma daecki* (E), *Ischnura kellicotti* (E), *I. posita* (C), *I. verticalis* (C).

Tropical and Eastern species (6, 5%) occur in the tropics south of Mexico and in eastern North America. Species in this category are: *Anax longipes* (E), *Erythrodiplax umbrata* (C), *Hetaerina titia* (E), *Argia violacea* (C), *Ischnura ramburi* (E), *Anomalagrion hastatum* (C).

Western species (12, 9%) extend from the Pacific Coast to a line from North Dakota south through Texas. Some occur also in Canada and in Mexico. Western species are: *Libellula comanche* (W), *L. saturata* (W), *L. subornata* (W), *Sympetrum o. fasciatum* (W), *Dythemis fugax* (W), *Brechmorhoga mendax* (W), *Hyponeura lugens* (W), *Argia alberta* (W), *Amphiagrion abbreviatum* (W), *Ischnura barberi* (W), *I. demorsa* (W), *I. denticollis* (W).

Tropical and Western species (5, 4%) occur in the tropics south of Mexico and in western North America. These species are: *Aeshna multicolor* (W), *Libellula croceipennis* (W), *Lestes alacer* (C), *Telebasis salva* (W), *Enallagma praevarum* (W).

Transcontinental species (12, 9%) cross the United States and/or Canada and may occur in Mexico or in other regions of the world. Transcontinental species are: *Gomphus graslinellus* (E), *Aeshna umbrosa* (C), *Libellula pulchella* (C), *Plathemis lydia* (C), *Sympetrum internum* (E), *S. vicinum* (C), *Tramea lacerata* (C), *Lestes dryas* (?), *L. unguiculatus* (E), *Argia moesta* (C), *A. sedula* (C), *Enallagma carunculatum* (W).

Transcontinental and Tropical species (12, 9%) occur in the tropics south of Mexico and also cross some part of North America. Some occur also in other regions of the world. Transcontinental and Tropical species are: *Anax junius* (C), *Orthemis ferruginea* (C), *Tarnetrum corruptum* (C), *Erythemis simplicicollis* (C), *Pachydiplax longipennis* (C), *Tramea onusta* (C), *Pantala flavescens* (C), *P. hymenea* (C), *Hetaerina americana* (C), *Archilestes grandis* (C), *Argia translata* (E), *Enallagma civile* (C).

Central species (8, 6%) are not reported from any Atlantic or Pacific state; some are very restricted, others extend from Ohio to Nevada. Central species are: *Gomphus lentulus* (E), *G. externus* (C), *G. militaris* (C), *G. oklahomensis* (E), *Macromia pacifica* (C), *Neurocordulia xanthosoma* (E), *Tetragoneuria petechialis* (C), *Somatochlora ozarkensis* (E).

Six species (5%) were not placed in any of the above categories. Records of the subspecies *Argia agrioides nahuana* and *A. vivida plana* are too few to determine accurately their ranges. *Gomphoides stigmatus* and *Argia immunda* are recorded from Texas and Mexico, and *Lepthemis vesiculosa* and *Dythemis velox* are present in Mexico, the Antilles, and southern United States.

Twenty-three of the 126 Oklahoma species occur in the tropics south of Mexico. Eleven of the 48 genera recorded from Oklahoma are listed by Tillyard (1917) as entogenic to Neotropica alone. This number exceeds the eight neotropical genera recorded from Louisiana (Bick, 1957) but not the 15 from Florida nor the 18 from Texas. Unlike the last three states, Oklahoma is removed from the Gulf Coast and from tropical areas. Yet because Oklahoma is in the path of migration from South America via Central America, Mexico, and Texas, this large number of neotropical genera is entirely reasonable.

The Oklahoma fauna is primarily eastern. The number of eastern species (65, 52%) exceeds all other entities combined in the preceding lists. Moreover, species in three other categories, Tropical and Eastern, Transcontinental, Tropical and Transcontinental, occur at least somewhere in eastern United States so that 95 species or 75 percent of the Oklahoma fauna is shared with eastern United States. In contrast, 17 species or 13 percent are in the two western categories. The two Transcontinental entities total 24 species or 19 percent of the fauna. Kennedy (1917) considers 55 percent of the 65 Kansas species Eastern, 28 percent Transcontinental, and 18 percent Western.

No species was restricted to Oklahoma but four, listed under Central, are recorded by Needham and Westfall (1955) from very limited areas: *Gomphus oklahomensis*, Oklahoma and Texas; *Neurocordulia xanthosoma*, Kansas, Oklahoma, and Texas; *Tetragoneuria petechialis*, Kansas, New Mexico, and Texas; *Somatochlora ozarkensis*, Missouri and Oklahoma.

Distribution within the state is summarized as follows.

Across Oklahoma 51 (40%)

Of these, 28 are eastern American species, 18 Transcontinental, four Central, and one Western.

Restricted to eastern Oklahoma	50 (40%)
Of these, 42 are eastern American species, four Central, and four Transcontinental.	
Restricted to western Oklahoma	17 (13%)
Of these, 16 are western American species and one is Transcontinental.	
United States or Oklahoma distribution unclassified	8 (6%)

Sixty-seven species (53%) were limited within the state and extended eastward or westward to the lines previously mentioned. Fifty species (40%) were restricted to eastern Oklahoma but only 17 (13%) to western Oklahoma. Blair and Hubbell (1938) state that 60 percent of the mammals and 70 percent of the orthopterans are restricted in an east or west direction in Oklahoma and that in each group the number of species restricted to eastern Oklahoma is the same as the number restricted to the western part of the state.

In contrast with the 67 species (53%) limited in an east or west direction, 10 species (8%) were restricted within Oklahoma in a north or south direction. Blair and Hubbell (1938) state that 24 percent of th orthopterans and 11 percent of the mammals reach either north or south limits in the state. Three of the odonates restricted in a north or south direction, *Gomphus oklahomensis*, *Teleallagma daecki*, and *Enallagma dubium*, are recorded from southeastern Oklahoma and four, *Gomphoides stigmatus*, *Libellula croceipennis*, *Lestes alacer*, and *Telebasis salva*, are primarily in southwestern Oklahoma. Based on United States distribution these probably do not extend farther northward. Only *Argia immunda* occurred across the entire southern half of the state. Two species appear to reach southern limits in Oklahoma. *Enallagma antennatum*, a northwestern United States species, and *Enallagma carunculatum*, a northern Transcontinental species, are recorded only from northwestern Oklahoma.

Blair and Hubbell (1938) divide Oklahoma into 11 biotic districts, each with characteristic physiography, climate, flora, mammals, and orthopterans. Odonate distribution differed in that no grouping of restricted species appeared to be characteristic of any one biotic province; instead most species occurred either throughout eastern or throughout western Oklahoma.

Most eastern species extended west to the western borders of Kay, Noble, Logan, Oklahoma, Cleveland, McClain, Garvin, Carter, and Love counties. Most western species extended east to the eastern borders of Kay, Pawnee, Payne, Lincoln, Pottawatomie, Pontotoc, Johnston, and Marshall counties. These 16 counties in the central part of the state constitute an area of overlap for eastern and western species.

There is a very wide range of precipitation in Oklahoma; Wahl-

green (1941) records 45 to 56 inches annual rainfall for the southeast and but 18 inches for the northwest. Correlated with these extremes of precipitation are the east-west changes in vegetation. In general terms the eastern part of the state is hardwood, or mixed pine and hardwood forest, the central part postoak-blackjack forest or tall grass prairie, and the western part short grass plains. The western limit in Oklahoma of eastern United States species, which do not cross the state, coincided with the principal western limit of the scrub-oak area as mapped by Duck (1943) and with the 32 inch rainfall line given by Wahlgreen (1941). Western United States species did not reach the eastern limit of the postoak-blackjack area and were absent in the forests of eastern Oklahoma. This eastern limit of western United States species was approximately the 36 inch rainfall line. Hence the 16 counties previously mentioned, with 32 to 36 inches of rainfall and with vegetation neither entirely grassland nor entirely forest, constituted an area of overlap for eastern and western faunas. Kennedy (1917) states that the line between eastern and western odonate faunas occurs on the plains east of Denver and west of Topeka, Kansas. The present study defines the zone of contact in Oklahoma more definitely.

There is a considerable difference in temperature between northern and southern Oklahoma; Wahlgreen (1941) gives an average January temperature of 44 degrees for the southeast and 32 degrees for the northwest. Yet because only eight percent of the species were limited in a north or south direction and 53 percent in an east or west direction, it seems clear that odonate distribution is correlated with the precipitation gradient and not with the temperature gradient. Blair and Hubbell (1938) reach the same conclusion for orthopterans and mammals in Oklahoma.

The more mesic conditions of eastern Oklahoma appeared to provide a barrier to the eastward extension of all but one western United States species. The more xeric conditions of western Oklahoma provided a barrier to the westward extension of 42 eastern United States species which did not go beyond the 32 inch rainfall line but not to 28 which crossed the state.

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euria and *Macromia* respectively and Mrs. L. K. Gloyd verified determinations of certain species of *Argia*.

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NOTES ON MEXICAN SNAKES (OPHIDIA)

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ABSTRACT. Sixteen species of Mexican snakes are discussed. Range extensions are noted for *Lampropeltis triangulum annulata*, *Lampropeltis getulus nigritus*, *Pituophis catenifer affinis*, *Toluca lineata lineata*, *Salvadora intermedia*, *Trimorphodon latifascia*, *Trimorphodon lambda*, and *Crotalus trigris*. An altitudinal record of 5,200 feet is reported for *Crotalus basiliscus basiliscus*. Additional data are presented on three rare snakes, *Lampropeltis getulus nigritus*, *Trimorphodon tau*, and *Leptodiera punctata*. *Crotalus intermedius gloydi* is considered a valid subspecies occupying the Oaxacan highlands. The name *Salvadora intermedia richardi* Smith appears to be based on an individual variant and should be submerged. The authors question the inclusion of *Lampropeltis polyzona* Cope in the species complex *Lamproeltis triangulum* and they suggest that *Salvadora bairdi* and *S. lineata* are not specifically distinct but rather are geographic races of *S. bairdi*.

In the course of gathering biological and distributional data on Mexican toads of the Genus *Tomodactylus* during June and July, 1956, the junior author and his wife, Mary, collected several specimens of Mexican snakes. Some of them are of particular interest in that they constitute new distributional records or are of taxonomic importance. All specimens here discussed are deposited in the Texas Cooperative Wildlife collection, Texas A. and M. College.

COLUBRIDAE

RHINOCHEILUS ANTONI ANTONI Duges. SINALOA: 4 mi. SE Escuinapa, 50 ft., 1 ad. ♀. SONORA: 31 mi. S Hermosillo, 500 ft., 1 yg. ♀. The adult specimen from Sinoloa is 802 mm. in length and has wide dark blotches characteristic of *antoni* but the interspaced rings are reddish, not white. The young female from Sonora agrees in scale counts with Klauber's (1941) account of the type of *antoni* but the dark blotches are blackish (not reddish brown) and are no more than twice (rather than about five times) the width of the whitish interspaces.

It is evident that considerable individual variation in color and size of the dark and light dorsal markings is present in this subspecies. The best diagnostic character seems to be the low number of ventrals—195–203 in males, 193–204 in females—combined with 20 or less dark body blotches.

LAMPROPELTIS TRIANGULUM ANNULATA Kennicott. VERACRUZ: Puente Nacional, 1100 ft., 1 ♂. This specimen agrees with *annulata* in all respects except that the scales in the red saddles are dark-tipped. The black bands are united ventrally underneath the red saddles, the white rings are complete ventrally, the top of the head from the parietals forward is black, the white rings on body and tail number 20, and the number of ventrals is 204. In these respects it agrees with *annulata* from Kerr and Cameron Counties, Texas. It differs markedly from a specimen of *polyzona* from Jalapa, Veracruz, chiefly in having the black bands united ventrally which creates red saddles instead of red rings.

This extends the known range of *annulata* into northern Veracruz and at the same time creates the anomaly of having two subspecies of *L. triangulum* occupying the same general area in that state. Consequently, we question Smith's (1942) inclusion of *polyzona* as a subspecies of *triangulum*.

LAMPROPELTIS GETULUS NIGRITUS Zweifel and Norris. SONORA: 8 mi. S Navojoa, 300 ft., 1 ♀. Zweifel and Norris (1955) described *nigritus* on the basis of two specimens from Sonora, one male from about 30 mi. S Hermosillo and one female from about 7 mi. SE Pitahaya. Our specimen constitutes the third known specimen of *nigritus* whose range can now be extended southward in Sonora nearly to Sinaloa.

Scale counts and measurements of our specimen, followed by those of the female paratype in parentheses, follow: Total length, 934 (902); length of tail, 130 (107); scale rows 25–26–22 (25–25–21); preoculars 1/1 (1/1); postoculars, 2/2 (2/2); supralabials, 7/7 (7/7); infralabials, 9/10 (10/10); ventrals, 221 (217); subcaudals, 51 (48).

Color of our specimen: Anterior two-thirds of dorsum dark brown, posterior one-third black; head completely black with an indistinct row of minute yellowish cream dots on lower edge of supralabials; lateral scales with brown centers surrounded by dark brown borders; chin black with two yellowish cream spots on anterior pair of chin shields; venter black with yellowish cream mottling anteriorly, dorsal, lateral, and ventral surfaces of tail completely black.

PITUOPHIS CATENIFER AFFINIS Hallowell. SINOLOA: 10 mi. NW Escuinapa, 150 ft., 1 ♂. This record extends the known range of *affinis* southward along the western coast of Mexico to southern Sinaloa. The anterior dorsal blotches of this specimen are brown, with saddle-shaped light interspaces, but anterior to the tail they blacken so that the last six body blotches are black as are those on the tail. The venter is cream color with four irregular rows of black or blackish

spots anteriorly, the two outer rows involving the ends of the scutes, the two inner rows situated at about the inner edge of the outer spots but on adjacent scales. Posteriorly the inner spots unite to form bars two scutes wide. A continuous midventral dark stripe with serrated edges is situated on the proximal half of the tail. Distally, the dorsal spots are united ventrally to produce rings.

In several respects the specimen resembles *vertebralis* of the Cape region of Baja, California, especially in the dark stripe under the tail and the black dorsal blotches on the posterior part of the body and on the tail. But it differs in lower ventral count, in having rhomboidal rather than saddle-shaped dorsal blotches, etc.

Measurements and scale counts follow: Total length, 846; tail, 122; scale rows, 29–31–23; ventrals, 229; subcaudals, 59; supralabials, 8/8; infralabials, 12/12; preoculars, 1/1; postoculars 4/4; 4th supralabial only in contact with eye; dorsal body blotches, 41; tail blotches, 12; anal entire.

TOLUCA LINEATA LINEATA Kennicott. OAXACA: 3 mi. W Yanhuitlán, 8700 ft., 3 ♂, 3 ♀; 10 mi. E Tamazulapan, 8200 ft., 1 ♀.

On geographic grounds these seven specimens should be referred to *T. l. varians* Jan or to *T. l. acuta* (Cope) (See Taylor and Smith, 1942). They lack the bold transverse dorsal spots found in *acuta* and differ from *varians* in having the second supralabial in contact with the prefrontal and the belly in all females is spotted or stippled. Peculiarly, all females have a tessellated dorsal pattern and spotted venter; all males have five distinguishable stripes and all but one has an immaculate belly.

If these specimens are actually *T. l. lineata*, which they appear to be to us, they represent the southernmost record for that race and a new record for Oaxaca. All specimens were collected on a steep hillside beneath large rocks within a pine-oak forest community.

Males (3): ventrals 118–122; subcaudals 35–36; supralabials 7/7; infralabials 6/6 (2) 7/7 (1); preoculars 1/1; postoculars 2/2; temporals 1–2; loreal absent except in one specimen on one side; total length (2 adults) 248, 260; tail 50, 53.

Females (4) ventrals 126–127; subcaudals 27–31; supralabials 7/7; infralabials 6/6 (3) 7/7 (1); preoculars 1/1; postoculars 2/2; temporals 1–2; loreal present (2); absent (2); total length (2 adults) 230, 235; tail 36, 38.

SALVADORA BAIRDI Jan. MICHOACAN: 3½ mi. W Zacapu, 7100 ft., 1 ♂ adult. This specimen is of particular interest because it seems to combine the color patterns of *bairdi* and *lineata*. The two dark paravertebral stripes diverge in the temporal region and continue through

the eye onto the loreal region, as in *lineata*, but the lateral dark stripes are distinct and completely separated from the paravertebral stripes anteriorly except in the temporal region where they join on one side but not on the other. It agrees with *bairdi* in having the lateral line distinct anteriorly as it does in having the anterior nasal separated from the second supralabial and the second pair of genials separated throughout their length. This last character, however, is also found in some specimens of *lineata*.

Consequently, on the basis of geographic position and the presence of certain of the characters mentioned above we are referring the specimen to *bairdi*. At the same time, we are inclined to the view that *bairdi* and *lineata* are not just closely related species as do Smith (1938) and Schmidt (1940), but rather that they are very likely subspecies of a single species, *S. bairdi*. Essentially, the two differ only in (1) the color pattern on the head and neck, which is not constant in either, (2) the size and shape of the rostral scale, (3) whether the anterior nasal does or does not contact the second supralabial, and (4) whether the second pair of genials are in contact or separated by small scales, a feature that also is variable. By treating them as subspecies their similarities are brought into focus. However, until more material is available for study we are regarding them as specifically distinct.

Measurements and scale counts: Total length, 1017; tail, 281; scale rows, 17–17–13; ventrals, 193; subcaudals, 104; supralabials, 8/8; infralabials 10/10; pre-and postoculars, 2/2.

Salvadora intermedia Hartweg. Oaxaca: 2 mi. ESE Yanhuitlán, 8300 ft., 2 ♂; 3 mi. NW Yanhuitlán, 8700 ft., 1 yg. These three specimens are of considerable interest because (1) this species heretofore has not been recorded from Oaxaca and (2) they come from a locality about 50 miles south of Tehuacan, Puebla, the type locality of *S. i. richardi* Smith, which name was based on a single specimen. The main differential characters attributed to *richardi* are (1) prenasal not in contact with second supralabial and (2) the large number of ventrals (189); in other characters *richardi* is said to agree with *intermedia* "in all pertinent details of color and pattern (including the pink belly), in form of rostral, number of labials and number of maxillary teeth" (Smith, 1941b:8).

Two of the specimens from Yanhuitlán have the prenasal separated from the second supralabial; in the third they are in contact. Neither of the adult males from Yanhuitlán has 189 ventrals; one has 184, the other 169. The young specimen has 181. Consequently, the range of variation in this character is much greater than was previously realized. This is doubly evident from the fact that a female of *S. inter-*

media from Almolonga, Guerrero, near the type locality, has 194 ventrals. Consequently the known variation in number of ventrals in specimens of *intermedia* from near the type locality is 172–194; in specimens from Yanhuitlán and Tehuacan it is 169–184. Because of this and the fact that the condition of the prenasal is variable, we are led to the conclusion that the name *richardi* is based upon an individual variant and should be placed as a synonym of *intermedia.*

Other pertinent data on these three specimens follow: Scale rows, 17–15–13 (2), 18–15–13 (1); ventrals, 184, 169, 181; subcaudals, 105, 93, 103; supralabials 8/8; infralabials 9/9 (2), 9/10 (1); preoculars 2/2; postoculars, 2/2; temporals, 2–2 (1), 2–3 (2); total length, 875, 762, 297; length of tail, 254, 222, 77.

TRIMORPHODON LATIFASCIA (Peters). NAYARIT: 5 mi. SE IXtlán del Río, 3850 ft., 1 ♂. Although this seems to be the first record of *latifascia* from Nayarit, its presence there was anticipated by Smith and Taylor (1945) who considered the snake of that general area to be a distinct species, *fasciolata.* Davis and Smith (1953), however, demonstrated that *fasciolata* is a synonym of *latifascia* whose range is now known to include the states of Puebla, Morelos, Guerrero, Michoacán, and Nayarit.

This specimen is a young male with the following measurements and scale counts: Total length, 505 mm.; tail, 97; scale rows, 22–21–17; ventrals, 220; subcaudals, 75; supralabials, 8/9; infralabials, 12/12; preoculars 3/3; postoculars, 3/3; loreals, 2/2. It has 19 dark body blotches plus 10 on the tail. The anteriormost blotch is 14 scales in length and all blotches are shorter laterally than dorsally and are interrupted ventrally. From mid-body posteriorly each is divided by a faint transverse white line.

This specimen differs in no essential manner from specimens of *latisfascia* from Morelos and Guerrero except in the number of scale rows just anterior to the anus, which is 17 rather than 15 in all other specimens we have examined.

TRIMORPHODON PAUCIMACULATUS Taylor. SINALOA: 6 mi. E Mazatlán, 50 ft., 1 ♂; 24 mi. N Mazatlán, 150 ft., 1 ♂; 36 mi. N Mazatlán, 500 ft., 1 ♀; 6 mi. N Coyotitan, 300 ft., 1 ♂. This relatively rare snake seems to be restricted to the lowlands of Sinaloa and Nayarit. When Smith (1941a) reviewed the genus he had only two specimens available, the type from Mazatlán and a specimen in poor condition from San Blas, Nayarit. Klauber (1940) listed two other specimens from Mazatlán in the Stanford University Museum.

Our four specimens have the following measurements and scale counts (female in parentheses): Total length, 1020, 945, 612, (630);

tail, 185 171, 108, (98); scale rows, 23–24–17–23–17, 25–24–15 (23–25–17); ventrals, 255, 248, 252 (253); subcaudals, 86, 87, 84 (75); supralabials 9/9 in males (8/9); infralabials, 14/14, 13/14, 12/12, (13/14); dark body blotches, 23, 18, 22 (21); dark tail blotches, 12, 11, 10 (11). These data compare favorably with those recorded by Smith *(op. cit.)*.

TRIMORPHODON LAMBDA Cope. SONORA: 16 mi. ESE Guaymas, 50 ft., 1 ♂; 37 mi. SE Navojoa, 300 ft., 1 ♂. The occurrence of this species at the locality 37 miles southeast of Navojoa extends its known range southward in Sonora to within 15 miles of the Sinaloan border. It is likely that it also occurs in northern Sinaloa.

This species is closely related to *paucimaculatus* but differs chiefly in having fewer ventrals and darker dorsal blotches. Intensive collecting between Mazatlán and the Sonoran border may reveal intergradation between the two.

Measurements and scale counts of our specimens follow: Total length, 547, 485; tail, 103, 90; scale rows, 21–23–17, 23–21–17; ventrals, 225, 236; subcaudals, 83, 82; supralabials, 9/9; infralabials 12/12; preoculars, postoculars, and loreals 3/3 in each; dark body blotches, 25, 24; tail blotches, 14, 14.

TRIMORPHODON TAU Cope. OAXACA: 17 mi. SE Nochixtlán, 6900 ft., 1 ♀ adult. This is another rare snake in Mexico. When Taylor reviewed the Mexican representatives of the genus in 1938 only the type of *tau* from Quiotepec, Oaxaca, was known. Smith (1941a) later reviewed the genus and listed only five specimens, three from Oaxaca and one each from Guerrero and Michoacán.

Our specimen has the following measurements and scale counts: Total length, 710; tail, 112; ventrals, 227; subcaudals, 64; supralabials 8/8; infralabials, 11/12; preoculars, 3/3; postoculars, 3/3; loreals, 3/3; dark body blotches, 23, the first beginning on the fifth scale behind the parietals; tail blotches, 10. The belly has two rows of dark spots involving the tips of one or two scutes and the first row of scales. Some of them represent ventral extensions of the dorsal blotches; the others are independent of the blotches. Each dorsal blotch is edged with black and is entire (not divided by a light cross band as in *lambda* and its allies) except for the first seven.

HYPSIGLENA TORQUATA (Gunther). NAYARIT: 23 mi. NW Tepic, 500 ft., 1 ♂. SINALOA: Villa Union, 100 ft., 1 ♀, 1 ♂; 39 mi. N Los Mochis, 100 ft. 1 ♂. The specimen from north of Los Mochis is of interest because it has no distinct light nuchal collar although in all other respects it agrees with *torquata*. At first glance it looks like *ochrorhynchus* but the postocular stripe is separated from the brown

nuchal collar and the scale count is like that of the three other specimens of *torquata*, except that there are 57 subcaudals (43–49 in the others). Scale counts on this specimen, a male, are ventrals, 172; subcaudals, 57; scale rows, 21–21–15; supralabials 8/8; infralabials, 10/10; preoculars, 2/2; postoculars, 2/2; temporals 1–2; loreals, 1/1. Ventral counts of the other three are 179 (♀), 166 (♂), 170 (♂); in one the preoculars are 1/2 on one side. Otherwise the counts are identical to those listed above.

LEPTODEIRA PUNCTATA (Peters), SINALOA: 3 mi. E Mazatlán, 50 ft., 1 ♀; 6 mi. NNW Mazatlán, 10 ft., 1 ♀. This snake is rare in collections. Our specimens have the following measurements and scale counts: Snout-vent length, 442, 431; tail ——, 131, scale rows, 19–19–15 in both; ventrals, 162, 153; subcaudals,——, 62; supralabials 7/7 in both; infralabials, 9/10, 8/9; preoculars 1/2, 2/2; postoculars 2/2 in both; temporals 1–2; loreal 1/1. Both specimens were found dead on the highway.

CROTALIDAE

CROTALUS BASILISCUS BASILISCUS (Cope). JALISCO: 2 mi. S Santa Cruz, 5200 ft., 1 ♀ yg. SINALOA: 2 mi. S Coyotitan, 300 ft., 1 ♂; 12 mi. S Culiacan, 300 ft., 1 ♂; 30 mi. N Los Mochis, 100 ft., 1 ♀; 16 mi. N Mazatlán, 200 ft., 1 ♀. This is a common rattlesnake in the lowlands of western Mexico. The previous altitudinal record of occurrence is 3200 feet in Michoacán (Klauber, 1956:496); consequently the record of 5200 feet in Jalisco is of special interest. This is a young female 335 mm. in total length with 178 ventrals and 27 subcaudals.

CROTALUS INTERMEDIUS GLOYDI Taylor. OAXACA: El Tejocote, 30 mi. NW Oaxaca City, 7500 ft., 1 ♀. Total length, 518 mm.; tail, 37 mm. plus rattles 14 mm.; scale rows 21–21–17; ventrals, 169; caudals 22. Dark dorsal blotches on body, 50; on tail, 7.

Since this specimen was taken in the same mountain range and within 30 miles of Cerro San Felipe where Taylor (1941) took the type and only known specimen of *Crotalus triseriatus gloydi*, it is of special interest because Klauber (1952) submerged the name as a synonym of *Crotal intermedius intermedius*. Type locality of the latter is considered to be El Limon Totalco, Veracruz, near Cofre de Perote.

Comparison of our specimen with Taylor's *(op. cit.)* description of *gloydi* and with the description and a paratype (TCWC 822) of Smith's (1946) *Crotalus gloydi latus* (= *C.i. intermedius*, according to Klauber) clearly indicates that although our specimen agrees in

many respects with the *intermedius* occurring at Totalco, it differs in having (1) a small postnasal that contacts only the first supralabial (a "diagnostic" character of *gloydi*) and (2) the lower preocular on each side is narrowly in contact with the loreal It differs from the type of *gloydi* in having (1) the post nasal in contact with the internasal, (2) two instead of three preoculars, and (3) three distinct rows of alternating dark brown spots on each side (in addition to the paravertebral row). Two of these features (nos. 1 and 3) agree with specimens of *intermedius* from Totalco and with many specimens of *C. i. omiltemanus* from Guerrero.

Because our specimen comes from an area so close to the type locality of *gloydi*, we believe it is a representative of that population. But, whether the population there is distinct or assignable to *intermedius*, as Klauber believes, or to *C. i. omiltemanus* is debatable. In our specimen the ventrals number 169—half way between the upper limits of variation for females of *intermedius* (157–165) and the lower limits of *omiltemanus* (173–185). In addition, there are 50 dark body blotches, a number that agrees well with the mean for *omiltemanus* (51) and 5 above the maximum for *intermedius* (see Klauber, *op. cit.*).

In comparing our specimen with a series of 9 recently (1953) preserved topotypical specimens of *omiltemanus*, we find no difference in the color pattern, but *omiltemanus* is noticeably darker (grayer) dorsally and much more heavily pigmented ventrally. Furthermore, in adults the white marks on the infralabials are much less pronounced. In all specimens the three rows of alternating blotches are distinct, at least at mid-body, as in *intermedius* and our Oaxacan specimen.

It is evident to us that the populations at (1) Totalco, (2) in the highlands of Oaxaca, and (3) the highlands of Guerrero comprise a single geographically varying species. The Oaxacan specimen appears to be intermediate not only geographically, but also morphologically between *intermedius* in Veracruz and *omiltemanus*, in Guerrero and at the same time not clearly referable to either. Consequently, we deem it advisable to resurrect *gloydi* from the synonymy of *intermedius* for the Oaxacan population.

This specimen was taken at night, during a heavy rain while it was climbing up the vertical face of a rock wall. The vegetation in the pass at Tejocote is mainly pines with a scattering of oaks.

CROTALUS TIGRIS Kennicott. SONORA: 17 mi. ESE Guaymas, 100 ft., 1 ♂. This specimen is of interest only in that it came from a locality south of Guaymas, which, according to Klauber (1952), constitutes a slight southward extension of the known range. It is a young

male with the following measurements and scale counts: Total length (exclusive of rattle), 688; tail to rattle, 60; ventrals, 165; subcaudals, 26; scale rows, 25–20–19; 44 transverse body bands; 7 tail bands.

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THE SOUTHWESTERN NATURALIST 2 (1): 28—32 JANUARY, 1957

SPRING ARRIVAL OF SUMMER RESIDENT BIRDS ON THE LOWER RIO GRANDE, NEW MEXICO

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ABSTRACT. The spring arrival dates in the Mesilla Valley, New Mexico, for eighteen species of summer resident birds are presented graphically.

The relatively orderly arrival of migrant birds to their breeding areas is a phenomenon fully appreciated but not documented for many specific areas in North America. This report is concerned with dates of arrival of summer resident birds in the Mesilla Valley, Dona Ana County, New Mexico.

The Mesilla Valley is part of the old flood plain of the Rio Grande. General elevations lie at about 3900 to 4000 feet. Much of the native riparian vegetation has been removed to make room for intensive agricultural and urban use of the area. There has also been serious overuse of the existing water supplies so that additional ecological change has occurred in association with a lowered water table.

Our data refer to a period in the history of the Mesilla Valley when these changes had not been fully effected; the picture we want to present will thus be more nearly representative of the one that existed prior to man's widespread use of the area. For this reason some birds, such as the Chat (*Icteria virens*), Yellow-billed Cuckoo (*Coccyzus americanus*), and the Painted Bunting (*Passerina ciris*), are treated here although they no longer occur sufficiently abundantly that adequate data can be recorded. Records we consider satisfactory exist from the period 1924 to 1940. In this time the senior author was in the employ of the United States Bureau of Reclamation and was in the field in a great variety of habitats practically all spring and early summer. His activities were such that a reasonably uniform type of observation was possible all during this time, except in 1927 and 1928. Thus, a maximum of 15 years of first dates are recorded for some species represented here, with a lesser number for the remainder.

Sample sizes (number of years for which we have reliable first records) are as follows: White-throated Swift, 6; Turkey Vulture, 12;

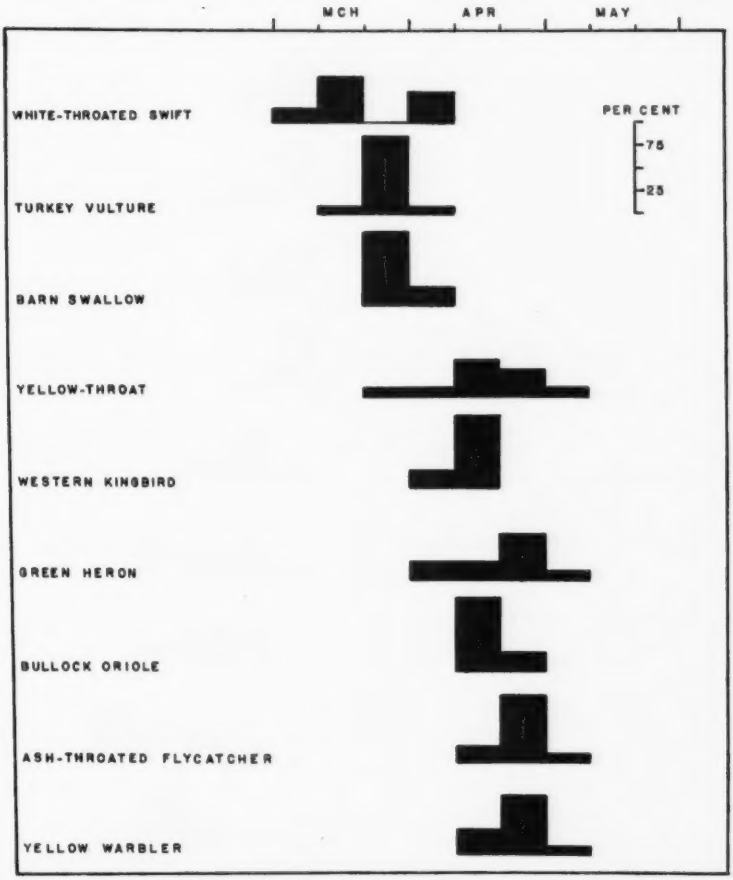

Fig. 1. Timing of arrival in the spring of summer resident birds to the Mesilla Valley, New Mexico: earlier arrivals. Columns of histograms represent ten-day intervals with the 5th, 15th, and 25th of each month as modes.

Barn Swallow, 15; Yellow-throat, 10; Western Kingbird, 15; Green Heron, 10; Bullock Oriole, 15; Ash-throated Flycatcher, 11; Yellow Warbler, 11; Booming Nighthawk, 12; Wood Pewee, 14; Lark Sparrow, 11; Summer Tanager, 13; Black-headed Grosbeak, 13; Chat, 9; Blue Grosbeak, 14; Yellow-billed Cuckoo, 9; Painted Bunting, 10.

Figures 1 and 2 show graphically the periods of time when these species can be expected to arrive in the Mesilla Valley. Each vertical column represents a ten-day interval, and absolute occurrence has

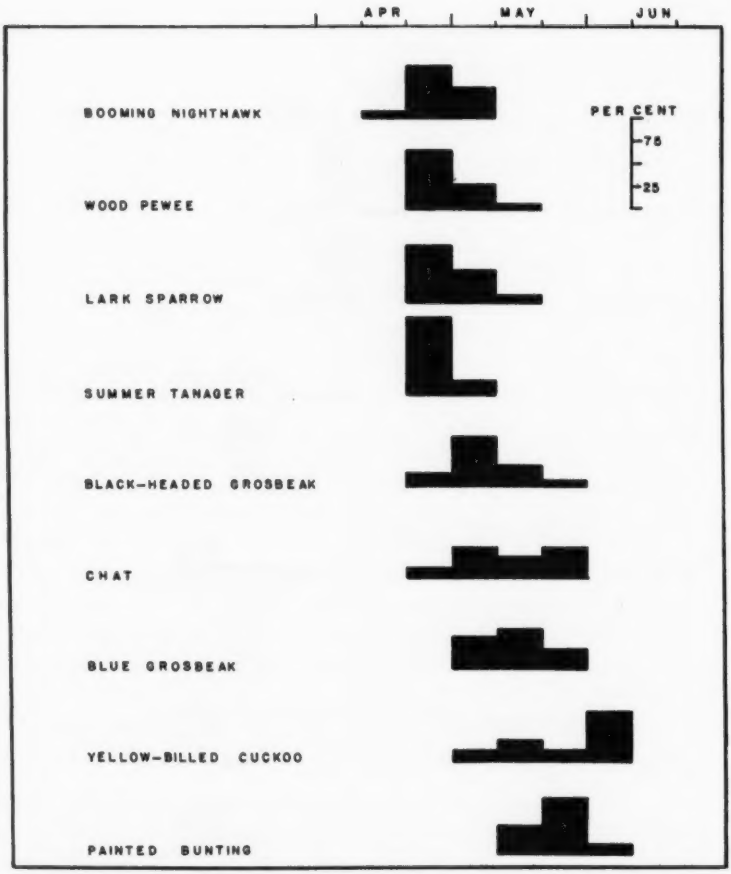

Fig. 2. Timing of arrival in the spring of summer resident birds to the Mesilla Valley, New Mexico: later arrivals. See fig. 1 for explanation of intervals.

been converted to percentage occurrence. The listing is one showing the earlier arrivals above later arrivals; in the case of the Wood Pewee, Lark Sparrow, and Summer Tanager, for instance, although our histograms show each to arrive at the same time, the earliest dates among the three are found in the Wood Pewee, and the latest in the Summer Tanager.

The regularity that some of the species show in arrival time is notable, and is in fact the kind of thing that lay observers expect of a species for any given area (*e.g.*, swallows and Capistrano, California).

Other species, however, do not show calendar regularity. The latter probably time their arrival at any point roughly with the chronology of yearly seasonality (for instance, as it pertains to the food resource); the former probably are guided by a relatively inflexible internal timing device (presumably oriented by a changing photoperiod).

NOTES ON SPECIES

BUTORIDES VIRESCENS. Green Heron.—This species is known occasionally to overwinter in the Mesilla Valley. We have attempted to exclude any such occurrences from the present data.

CATHARTES AURA. Turkey Vulture.—Eighty per cent of the records here fall into the period March 21 to 31. Since courtship, incubation, rearing of the young, and the molt in the aggregate require a great amount of time in a bird this large, it would seem reasonable to expect this cycle to begin early in the year. The only unvarying timing mechanism available to the species would be the photoperiod, and thus the small variation in timing of arrival would seem to be expected.

COCCYZUS AMERICANUS. Yellow-billed Cuckoo.—Arrival dates for this cuckoo form a histogram (fig. 2) unlike that for any other species treated here. Since this bird is a notably shy one around Mesilla it is possible that early migrants to this region have been overlooked, thus contributing to the strong mode in early June.

CHORDEILES MINOR. Booming Nighthawk.—The bulk of arrival dates for nighthawks are in the last week in April and the first week in May. In years with abundant early flights of insects some few nighthawks may arrive by mid-April.

AERONAUTES SAXATALIS. White-throated Swift.—This bird is known occasionally to over winter in the Mesilla Valley. Thus, early records shown here actually may be of birds that did not migrate. In any case, this species can be seen the earliest of any of the strictly non-resident forms treated here.

TYRANNUS VERTICALIS. Western Kingbird.—Kingbirds show one of the most highly restricted periods of arrival to this area with more than three-quarters of all records falling into the period April 10 to 20. It would appear that this is evidence of a relatively precise internal chronometer responding to photic environmental stimuli.

MYIARCHUS CINERASCENS. Ash-throated Flycatcher.—This species also has a relatively precise response to photoperiodic phenomena. It is not, however, as marked as with the kingbird; possibly this is further evidence on the degree of relationship between the genera *Tyrannus* and *Myiarchus*, known already to be clearly separated within the Tyrannidae.

CONTOPUS SORDIDULUS. Wood Pewee.—The histogram (fig. 2) shows an abrupt period of arrival, and a fairly restricted total period of arrival. There seems to be no obvious similarities in migratory behavior between this tyrannid and the preceding two.

DENDROICA PETECHIA. Yellow Warbler.

GEOTHLYPIS TRICHAS. Yellow-throat.

ICTERIA VIRENS. Chat.—The three warblers listed seem to show two clearly different responses to environmental factors in timing of migration. The Yellow Warbler has a fairly precise and limited time of arrival whereas the other two species appear to be much less strictly bound to any schedule. The Yellow-throat especially shows variable response, arriving over a period of about 50 days, longer than for any species treated here, but withall similar to the Chat.

ICTERUS BULLOCKII. Bullock Oriole.—This species shows a quite precise response

to migratory stimuli and seems to be more sensitive to the photoperiodic variation rather than to other factors.

PIRANGA RUBRA. Summer Tanager.—This species is one of the most unvarying in its time of arrival of all treated here.

PHEUCTICUS MELANOCEPHALUS. Black-headed Grosbeak.

GUIRACA CAERULEA. Blue Grosbeak.

PASSERINA CIRIS. Painted Bunting.—These three richmondenine finches comprise a group that shows the latest timing of arrival to the Mesilla Valley. These birds presumably evolved from tropical ancestors (Mayr, Wilson Bulletin, 58, 1946: 27) and as such they may require the clearly warm, subtropical environment that is reached in the Mesilla area only by about the month of May.

CHONDESTES GRAMMACUS. Lark Sparrow.—This finch arrives in late April and early May with a good deal of regularity and little spread in time.

Of the 15 species handled by Weston (1948) in a fashion similar to that here, only three are duplicated in the present group. Generally, times of arrival similar to those found at Berkeley, California, were noted for the Wood Pewee, Yellow Warbler, and Black-headed Grosbeak. Data for the Yellow Warbler are almost identical at both localities; slightly more restricted times of arrival were noted for the other two species in the Berkeley area. Additionally, the histogram (fig. 2) for the Wood Pewee shows an early strong modality in the last third of April but at Berkeley it shows the strong modality in the first 10 days of May. Finally, the Black-headed Grosbeak is seen to arrive a good 10 days later at Mesilla than at Berkeley.

These minor differences doubtless reflect differences in environmental variables to be expected between two stations of different latitude, longitude and altitude, and which have attendant differences resulting from a maritime versus a continental climate. The important thing is that the patterns of arrival dates do show a basic similarity in these disparate localities, indicating a broad, basic response by birds to (probably) photic phenomena as the primary regulator of migratory timing, according to the mechanisms as described in Farner's summary (1955).

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VERTEBRATES FOUND IN OWL-PELLETS FROM NORTHEASTERN CHIHUAHUA

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ABSTRACT. Owl-pellets from a small, rocky cave in northeastern Chihuahua yielded remains of at least 277 individuals of vertebrates, mostly small mammals, including the first desert shrews (*Notiosorex crawfordi*) from the state, and a chipmunk (*Eutamias* sp.) more than 100 miles from its nearest known occurrence. The fauna is characteristic of the Southwestern Desert.

Owls regurgitate pellets consisting of undigested parts of animals they have eaten, such as hair, feathers, and bone. These pellets may accumulate and be readily obtained. Study of them reveals (1) the foods taken by the owl, (2) the seasonal differences in food habits if the pellets are collected at appropriate intervals, or (3) the relative abundance of the different species being taken by the owl. For the period from 1935 to 1951 no less than 30 papers dealing with owl-pellets were listed by Neil Hotchkiss in 1954 (Wildlife Abstracts, 1935–51: An Annotated Bibliography of the Publications Abstracted in the Wildlife Review, Nos. 1–66; U.S. Govt. Printing Office; 435 pp.). These papers vary in scope from studies of a few pellets to a Danish study based on 14,000 pellets of the barn owl.

The material here reported was collected by the senior author in a cave on the rocky south slope of a range of mountains 3½ miles east-southeast of Los Lamentos (also called Felix U. Gomez), at 1420 meters elevation, in northeastern Chihuahua, on July 9, 1956. The natural history of this part of the state is poorly known.

The area in which this cave was found is representative of the northeastern half of Chihuahua. The mean annual rainfall is probably less than ten inches and rain may be erratic in occurrence. There is great seasonal variation in temperature; the highest and lowest readings at Ciudad Juarez from 1821 through 1930, for example, were 45 and minus 15 degrees Centigrade. Physiographically the area consists of extensive, poorly drained, and consequently relatively alkaline, basins and plains between scattered, low, rocky mountain ranges. Vegetation is scant. The dominant plant of the basins is the creosote bush, *Larrea tridentata*. Other characteristic plants of the slopes are yucca and ocotillo *(Fouquieria)*. Mesquite *(Prosopis)*, grasses, and cacti are less conspicuous than the above plants. Except after rains, the open water

nearest to the cave is in a stock-tank at the Rancho La Máquina some seven miles to the west.

The cave in which the pellets were found was approximately eight feet in diameter at the entrance and became progressively narrower until the back was reached 15 feet within the hillside. The floor sloped downward to the entrance and was littered with rocks of various sizes, between which were found the remains of owl-pellets in all parts of the cave. The cave had been occupied by bats near the back, and by wood rats, as evidenced by their fecal droppings, although neither animal was seen.

The broken and scattered material precluded analysis pellet by pellet. All obviously identifiable skulls and other parts on the surface were picked up. Then the aggregate between the rocks over approximately the one-fifth of the floor containing the most pellets was searched for identifiable elements; finally two quarts of the finer aggregate in three places where smaller vertebrates seemed to dominate were taken in entirety. Later, in the museum, we sorted all of the materials, and the junior author carefully sieved the finer aggregate with a graded series of meshes. In this way a number of small elements were recovered. These included parts of shrews and bats, and even hyoid bones and penis bones of rodents. In certain parts of the cave the bones were mostly those of smaller vertebrates such as *Perognathus* and *Peromyscus*, and in other places the bones were mostly those of larger vertebrates such as *Dipodomys* and *Sylvilagus*. This may indicate that more than one kind of owl contributed or that different owls of one species had individual preferences in food. Other explanations are possible. In any event we do not know the species of owl or owls concerned. The above factors influenced our sample and suggest that its value is in showing that certain species occur in the area, and less precisely in showing their relative abundance.

The number of individuals of each kind listed in the following tabulation is the minimum number that could have contributed the elements observed.

MAMMALS

Perognathus (*flavus* ?), Pocket Mouse	70
Sigmodon hispidus, Cotton Rat	42
Reithrodontomys sp., Harvest Mouse	32
Anthrozous pallidus, Pallid Bat	29
Notiosorex crawfordi, Desert Shrew	16
Dipodomys sp., Kangaroo Rat	16
Peromyscus sp., White-footed Mouse	11
Perognathus sp., Pocket Mouse	9
Sylvilagus sp., Cottontail	8
Onychomys sp., Grasshopper Mouse	6
Cratogeomys castanops, Pocket Gopher	3

Neotoma albigula, White-throated Wood Rat	2
Neotoma micropus, Gray Wood Rat	2
Neotoma sp., Wood Rat	2
Eutamias sp., Chipmunk	2
Tadarida brasiliensis, Free-tailed Bat	1
Sylvilagus floridanus, Eastern Cottontail	1
Lepus californicus, Black-tailed Jack Rabbit	1
AMPHIBIANS	
Scaphiopus sp., Spadefoot Toad	1
REPTILES	
Phrynosoma cornutum, Texas Horned Lizard	3
Phrynosoma modestum, Round-tailed Horned Lizard	1
Cnemidophorus sp., Race Runner	3
Iguanidae, genus not identified	6
BIRDS	
Molothrus ater, Cowbird	1
Mimus polyglottos, Mockingbird	1
Callipepla squamata, Scaled Quail	1
Lophortyx douglasii, Elegant Quail	1
Passeriformes, not identified	6
TOTAL	277

The most abundant animals were small *Perognathus* of the species *P. merriami* or *P. flavus*. We know of no certain means of distinguishing the fragments available, primarily anterior parts of skulls and lower jaws. *P. merriami* is said to be larger, to have a more well developed rostrum, and to have the lower premolar in comparison to the first lower molar relatively larger than in *P. flavus*. Fragments were examined with these characters in view and seemed in most cases nearer to *P. flavus*. It should be noted however that on the basis of any one of these characters by itself some individuals will be misidentified. The extremes for any single character in the two species overlap in approximately ten per cent of individuals. On geographic grounds both species are expected to occur in this area. *Perognathus* of a larger size than either *P. merriami* or *P. flavus* was represented by the anterior parts of nine skulls. These may be *P. penicillatus* or *P. intermedius*. No *Perognathus hispidus* was found. The left bullae of 16 *Dipodomys* were present. *D. ordii* and *D. merriami* were both trapped in the vicinity, and are probably represented in the owl-pellets although they can not be distinguished in fragments. No *Dipodomys spectabilis* was found.

The large numbers of cotton rats and of harvest mice were surprising because grass, the usual habitat of these species, was scarce nearby. When the *Sigmodon* and *Reithrodontomys* were discovered in the pellets suitable habitat was sought and was found on alluvial washes along the flank of the mountain one mile to the west of the cave. As our drinking water was gone the field party left the area

without trapping specimens of either genus. The *Reithrodontomys* were either *R. megalotis* or *R. montanus*, or both; no *R. fulvescens* was recognized.

The pallid bat, the most common bat of the area, was seen emerging from beneath large boulders and flying after dusk; one specimen was shot in flight eight miles east-southeast of Los Lamentos. The only other bat in the pellets was a common free-tailed bat, *Tadarida brasiliensis mexicana*, known from a complete skull, one scapula and one innominate bone.

The desert shrew is a species more readily taken by owls than by naturalists judging from its rarity in collections. The species has not been recorded previously from Chihuahua. The rostra of 13 skulls were recovered, and the right rami of 16 mandibles. On the basis of wear on the teeth two distinct age-classes were observable; there were 10 young animals and 3 older ones.

Peromyscus maniculatus, the deer mouse, was the only *Peromyscus* trapped. The 11 right rami and other fragments of *Peromyscus* could not be identified to species. The jaws of six grasshopper mice, *Onychomys*, were distinguishable from those of *Peromyscus* by the longer coronoid processes. On geographic grounds we judge that the *Onychomys* are probably *O. torridus*, although *O. leucogaster* may possibly occur.

Of the nine cottontail rabbits represented, one auditory bulla of a young animal was identifiable as *Sylvilagus floridanus*. The jaw of one adult was probably of the same species. The other specimens, seven palates, were of one adult, one subadult, and five young, and resembled *Sylvilagus audubonii*, although unequivocable identification was not possible. The one black-tailed jack rabbit was an immature individual. Four of the six wood rats were identified, and the two others may have been of the same species.

The chipmunks, *Eutamias*, are represented by the undamaged right and left parietal bones of one individual, by another left parietal bone and by one innominate bone. The species is not determinable. The nearest records of *Eutamias (E. dorsalis)* are more than one hundred miles distant in the mountains of western Chihuahua to the west and in the mountains of west Texas to the east. The mountains in northeastern Chihuahua are neither so extensive nor so high as those of west Texas across the Rio Grande. Until complete specimens are seen or obtained in northeastern Chihuahua their identity and exact habitat will remain unknown. They should be sought in the higher, more sheltered canyons of the desert ranges.

The distal end of the femur of a spadefoot toad, not identified to

species, was the only remnant of an amphibian discovered. The Texas horned-lizard was recognizable from cranial plates bearing horns and from one almost complete axillary skeleton with adherent dorsal skin. The round-tailed horned-lizard was represented by an almost complete skull. Other lizards were identified from fragments of jaws only.

The desert character of the fauna in the above list is evident in the species present and their relative abundance, especially in the numbers of *Perognathus* and *Dipodomys*. The most surprising finds were the large number of *Notiosorex*, not previously taken in the state, and the *Eutamias*, as yet unidentified but in any event an interesting extension of known range.

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SYNOPSIS OF THE GENUS EUSTOMA (GENTIANACEAE)

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ABSTRACT. Key, synonymy, and geographic distribution are given for the 3 recognized species. *E. Barkleyi* Standley (Coahuila, Mexico), is described as new, and the following new combinations are published: *E. grandiflorum* (Raf.) (replacing *E. Russellianum*), with f. *bicolor* (Standley), f. *Fisheri* (Standley), f. *flaviflorum* (Cockerell), f. *roseum* (Standley).

Nominally all the hitherto described species of *Eustoma* were treated by Small in 1903, but the treatment then given was so inaccurate as to be really worse than none. Floral measurements are given which do not apply to the species under which they appear, and indicate no significant differences; the key characters employed will not separate specimens in any acceptable fashion. Even the accentuation marked for the generic name is incorrect: the accent belongs on the first syllable, not the second. The synopsis here given, based on a total of 83 specimens in the Herbarium of Southern Methodist University and 153 in that of The University of Texas, is nearly the same as the one in Gray's Synoptical Flora, with the addition of a previously undescribed Mexican species. There appears to be very extensive introgressive hybridization between the two most wide-ranging species where their ranges overlap in southern Texas, so that a full account of the genus can be given only after detailed genetic and biometric study. The present synopsis is intended merely to distinguish the basic taxons, and to clarify the nomenclature as far as possible. Because all the known species occur in Texas and adjacent Mexico, it is felt that the material examined is sufficient for an account at the level of synopsis.

I am indebted to Dr. B. C. Tharp and Mr. W. L. McCart for the loan of The University of Texas collections, and to Mrs. Lazella Schwarten of the Gray Herbarium-Arnold Arboretum for supplying a photostat of the plate and text of Salisbury's Paradisus Londinensis describing the genus *Eustoma*.

EUSTOMA Salisbury, Paradisus Londinensis t. 34. 1806. Only species: *E. silenifolium* Salisb. = E. EXALTATUM (L.) Salisb. ex G. Don.

Dupratzia Rafinesque, Fl. Ludov. p. 54. 1817. Only spcies: *D. scoparia* Raf. = E. EXALTATUM (L.) Salisb.

Bilamista Raf., New Fl. N.A. 4: 93. 1838. Only species: *B. grandiflora* Raf. = E. GRANDIFLORUM (Raf.) Shinners, below.

Urananthus (Grisebach) Bentham, Pl. Hartw. p. 46. 1840. Based on *Chlora* sec. *Urananthus* Griseb., Gen. et Sp. Gent. p. 118. 1839. Type species: *U. glaucifolius* (Jacquin) Benth. = E. EXALTATUM (L.) Salisb.

Arenbergia Martens & Galeotti, Bull. Acad. Brux. 11/1: 373. 1844. (Not seen.) Type: Only species: *A. glauca* Mart. & Gal. = E. EXALTATUM (L.) Salisb. (*Fide* Index Kewensis.)

"*Enstoma* A. Juss. in Orb. Dict. 6: 78." 1849. (As listed in Index Kewensis.) An evident misprint for *Eustoma*.

KEY TO THE SPECIES

Middle leaves 2–5 mm. wide, 6–12 times as long as wide ..... 1. *E. Barkleyi*

Middle leaves (2–)8–40 mm. wide (smallest measurements from very dwarf plants), 2–5 times as long as wide

Calyx 0.9–1.7 times as long as the tube of the corolla; calyx 1.0–2.1 cm. long in flower, up to 2.3 cm. in fruit; lobes of corolla 1.4–2.6 cm. long ..... 2. *E. exaltatum*

Calyx (1.2–)1.8–3.0 times as long as the tube of the corolla (lowest ratio associated with largest corollas); calyx 1.4–2.8 cm. long in flower, up to 3.3 cm. in fruit; lobes of corolla 2.5–5.0 cm. long ..... 3. *E. grandiflorum*

1. E. **Barkleyi** Standley, in herb.; sp. nov. Perennis gracilis 12–45 cm. alta multicaulis caulibus e basi divaricato-ramosis. Folia angustissima lineari-oblanceolata vel linearia acuta vel acuminata, mediocria ad 5 mm. lata, 60 mm. longa, suprema multo minora. Flores solitarii vel pauci corymbosi longe pedunculati. Calyx 8–13 mm. longus (tuba 1.0–3.5 mm., lobi attenuati 7–10 mm.). Corollae tuba 5–11 mm. longa, lobi anguste vel latissime obovati 14–25 mm. longi apiculati. Stigma bilobatum. Capsula ellipsoidea vel cylindrico-ellipsoidea obtusa 9–15 mm. longa. HOLOTYPE: inside hot springs enclosure, Ojo de Caliente (33 miles southwest of Monterrey), Coahuila, Mexico; *A. Hernandez C., Chester M. Rowell & Fred A. Barkley 16M548*, 12 July 1946 (TU, with 4 isotypes). PARATYPES (all TU): same locality, limestone (travertine) and talc-like soil on gravelly hill, near stream, rare, *Barton H. Warnock & Fred A. Barkley 14746M*, 1 December 1945; same locality, travertine soil, *Maie W. & Fred A. Barkley 17M311*, 8 June 1947.

The open branching and very narrow leaves make this very distinct in a genus whose species are separated only by vegetative and size

differences. It is allied to *E. exaltatum* in its small flowers. As noted under *E. grandiflorum*, there appears to be introgression between it and *E. Barkleyi*, while the variation among the various collections of the new species, and occurrence of *E. exaltatum* also at the same locality, give presumptive evidence that natural hybridization has occurred involving all three.

2. E. EXALTATUM (L.) Salisbury ex G. Don, Gen. Hist. Dichlam. Plants 4: 211. 1837 (title page: 1838). (This combination implied but not actually made by Salisbury in Parad. Lond. t. 34, 1806.)

Gentiana exaltata L., Sp. Pl. ed. 2 p. 331. 1762. Based on Plumier, Sp. 3. ic. 81. f. 1, 1756; "Habitat in America" (more specifically, the West Indies). According to Urban (1920, p. 53), the figure, which must be regarded as the holotype, represents this species.

Lysianthus exaltatus (L.) Lamarck, Ill. 1: 478. 1791.

Chlora exaltata (L.) Griseb., Gen. et Sp. Gent. p. 118. 1839.

Lysianthus glaucifolius Jacq., Ic. Pl. Rar. 1 t. 33. 1781 (Not seen.)

Urananthus glaucifolius (Jacq.) Benth., Pl. Hartw. p. 46. 1840.

Eustoma silenifolium Salisb., Parad. Lond. t. 34. 1806.

Dupratzia scoparia Raf., Fl. Ludov. p. 54. 1817.

Erythraea Plumieri H.B.K., Nov. Gen. et Sp. Pl. 3 (quarto ed.): 178. 1819 (title page: 1818). Isotypic with *Gentiana exaltata* L., which is cited as synonym.

Urananthus chironioides Benth., Pl. Hartw. p. 47. 1840. "In Mexico prope Chico."

Eustoma chironioides (Benth.) Griseb. in DC., Prodr. 9: 51. 1845. (Placed in synonymy under *E. exaltatum* by W. B. Hemsley, Biol. Cent.—Am. Botany 2: 348, 1882, without comment, although Bentham & Hooker, Gen. Pl. 2 (2): 812, 1876, had stated "ad *Erythraeam* referendum est.")

Arenbergia glauca Mart. & Gal., Bull. Acad. Brux. 11/1: 374. 1844. (Not seen.)

Eustoma exaltatum var. *albiflorum* Chamisso & Schlechtendal, Linnaea 6: 387. 1831. HOLOTYPE (not seen): Papantla, Mexico.

Eustoma exaltatum f. *albiflorum* Benke, Rhodora 35: 44. 1933. HOLOTYPE (not seen): Brownsville, Cameron Co., Texas, *Benke 5409*, 25 March, 1930 (F).

Damp prairies or low open ground, in more or less alkaline or saline soil; southernmost United States, Mexico, British Honduras, and the West Indies. Flowering June–November. In Mexico the plants tend to be rather open-branched, approaching *E. Barkleyi;* in southern Texas and Louisiana they are more strict, resembling *E. grandiflorum.* Corolla color is usually lighter than in the latter species and more

gradually variable, passing to white. A yellow-flowered form may occur in extreme southern Texas (see remarks under *E. grandiflorum* f. *flaviflorum*, regarding uncertain identity of *E. Russellianum* var. *flavum*). Specimens have been examined from the following countries, states, and counties or districts.

UNITED STATES. CALIFORNIA: San Bernardino. FLORIDA: Levy, Monroe. LOUISIANA: Cameron. NEW MEXICO: Chavez, Eddy, Guadalupe. TEXAS: Aransas, Brazoria, Brewster, Calhoun, Cameron, Chambers, Galveston, Gonzales, Hidalgo, Jefferson, Karnes, Kenedy, Kleberg, Nueces, Pecos, Presidio, Reeves, San Patricio, Travis, Val Verde, Waller, Willacy.

MEXICO. CHIHUAHUA, COAHUILA, GUERRERO, NUEVO LEON, SONORA, TAMAULIPAS.

BRITISH HONDURAS. Belize District.

BAHAMA ISLANDS. North Bimini.

3. E. **grandiflorum** (Raf.) Shinners, comb. nov. *Bilamista grandiflora* Raf., New Flora N.A. 4: 93. 1838. "Red River, Louisiana and Arkanzas," at least partly based on specimens collected by Nuttall.

Lisianthus Russellianus Hooker, Bot. Mag. t. 3626. 1839. "Specimens and seeds of this plant were among the last of the many novelties that were sent home by the lamented DRUMMOND from San Felipe de Austin, Texas, in 1835."

Eustoma Russellianum (Hook.) G. Don ex Sweet, Hort. Brit. ed. 3 p. 473. 1839.

Urananthus Russellianus (Hook.) Benth., Pl. Hartw. p. 46. 1840.

Eustoma Andrewsii A. Nelson, Proc. Biol. Soc. Wash. 17: 177. 1904. HOLOTYPE (not seen): near Boulder, Colorado, *D. M. Andrews*, in 1904 (US).

Because of their evolutionary and horticultural importance, Latin names are supplied for the known color forms, as follows:

NORMAL (corolla blue-purple with darker center): f. GRANDIFLORUM.

WHITE: E. GRANDIFLORUM f. **Fisheri** (Standley) Shinners, comb. nov. *E. Russellianum* f. *Fisheri* Standley, Rhodora 34: 176. 1932. HOLOTYPE (not seen): Evergreen, Galveston Co., Texas, *G. L. Fisher* 5, 20 June 1931 (F).

WHITE WITH PURPLE-TINGED LOBES: E. GRANDIFLORUM f. **bicolor** (Standley) Shinners, comb. nov. *E. Russellianum* f. *bicolor* Standley, Field Museum Publ. Bot. 22: 97. 1940. HOLOTYPE (not seen): Willis, Montgomery Co., Texas, *C. L. Brock 32114*, 4 July 1932 (F).

PINK: E. GRANDIFLORUM f. **roseum** (Standley) Shinners, comb. nov. *E. Russellianum* f. *roseum* Standley, Field Museum Publ. Bot. 22: 97. 1940. HOLOTYPE (not seen): Willis, Montgomery Co.,

Texas, *G. L. Fisher 32116*, 5 July 1932 (F). (Fisher collections of f. *grandiflorum* from Willis have been examined, indicating that the color variants do belong to this species and not to *E. exaltatum*.)

YELLOW: E. GRANDIFLORUM f. **flaviflorum** (Cockerell) Shinners, comb. nov. *E. Russellianum* f. *flaviflorum* Cockerell, Torreya 24: 50. 1924. HOLOTYPE (not seen): near Denver, Colorado, *Mrs. S. B. Walker*, in 1914 (Colo. State Museum) .—? *E. Russellianum* var. *flavum* A. M. Davis, Nature Leafl. Lower Rio Grande Nature Club no. 2 p. 2. 1945. HOLOTYPE (not seen): coastal prairie, recent delta area of Cameron Co., Texas, *L. Irby Davis*, in May, 1942 (TU, according to author, but specimen has not been located). This may be a form of *E. exaltatum*, which is the common species in the type area. Mr. L. Irby Davis informs me that the yellow form is similar in size to the other plants in the area. Because *E. grandiflorum* and intermediates may also be found there, it is impossible to say which species var. *flavum* belongs to without actually measuring specimens. Despite repeated search, the holotype has not been found, and no isotypes or topotypes have been available for examination.

Same habitats as *E. exaltatum;* rather common (but becoming exterminated in many localities in recent years) from central Texas into Oklahoma, locally north to Colorado and Nebraska, also locally south to coastal Texas, and a single record from northern Mexico (Coahuila, at the type locality of *E. Barkleyi*, a narrow-leaved form approaching that species). Flowering mid June–September. Variable as to leaf-shape and capsule shape, which offer no bases for differentiating between this species and *E. exaltatum*. The living populations of *E. grandiflorum* have been strongly influenced apparently by introgression from *E. exaltatum* in the southern part of its range, and from *E. Barkleyi* at one locality. They have also been influenced rather locally by spontaneous genetic mutations, as shown by the spotty occurrence of several color forms (almost entirely limited, so far as known, to the cited type localities). I am not able to read into the picture any of that intense selection-pressure so beloved of the Neo-Darwinians. The somewhat weedy behavior of the plants, the erratic appearance of color variants, the tendency for plants to be either annual or perennial in different parts of the range of the species, all suggest that whatever evolution is going is due to internal genetic changes, with only minor influences from the external environment. Specimens have been examined from the following countries, states, and counties.

UNITED STATES. Colorado: Jefferson. Kansas: Stafford. Nebraska: Kearney. Oklahoma: Cleveland, Harper, Jefferson, Payne, Pottawotamie, Woods. Texas: Bell, Bexar, Burnet, Callahan, Cameron, Clay, Coleman, Comal, Comanche, Dallas,

Denton, DeWitt, Ellis, Erath, Fayette, Gonzales, Hamilton, Harris, Hood, Hutchinson, Jeff Davis, Jefferson, Johnson, Kendall, Kerr, Lubbock, McLennan, Mitchell, Montague, Montgomery, Palo Pinto, Pecos, Randall, Runnels, San Jacinto, San Saba, Tarrant, Taylor, Terrell, Travis, Val Verde, Walker, Washington, Wichita, Williamson.

MEXICO. COAHUILA (narrow-leaved form, approaching *E. Barkleyi*, from type locality of latter).

NAMES OF DOUBTFUL APPLICATION

E. gracile Engelm. ex A. Gray in Brewer & Watson, Bot. Calif. 1: 621. 1876. *Nomen nudum* (cited here because of later ambiguity as to type and circumscription). "*E. Russellianum*, very ornamental in cultivation, belongs to Texas and adjacent districts. *E. gracile* Englem., ined., of Northern Mexico, is perhaps a slender variety of it." (No authentic specimens examined. Presumably a lectotype would have to be designated among material at the Missouri Botanical Garden.)

E. Russellianum var. *gracile* (Engelm., ined.) A. Gray, Syn. Fl. N.A. 2 pt. 1: 116. 1878. "S. Texas, Berlandier &c. (Mex.)"

E. gracile Engelm. ex Small, Fl. S.E. U.S. p. 926. 1903. "On plains, southern Texas and northern Mexico."

As defined in the last two citations, *gracile* is certainly a form of *E. grandiflorum*, apparently modified by introgression with *E. exaltatum*.

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NOTE

WAHLENGERGIA MARGINATA (THUNB.) A. DC. (CAMPANULACEAE) IN LOUISIANA.—This native of Old World tropics and subtropics (primarily southeastern Asia) appeared as a weed in Florida about 20 years ago, and has been reported also from Georgia and Alabama. (See accounts by Dr. Rogers McVaugh: Notes on North American Campanulaceae. 2. The genus *Wahlenbergia* in the North American flora. BARTONIA 23: 36–37, 1945.—Botanical records of field work in the Southern United States in 1945 and 1947. *Wahlenbergia marginata.* FIELD & LAB. 17: 141, 1949.) A single small plant of it was found on sandy roadside 2.5 miles northeast of Glenmora, Rapides Parish, Louisiana, 5 May 1956, *Shinners 23, 264.* The species is also represented in the SMU Herbarium by a half dozen other U.S. collections, among them previously unreported records for two counties in Florida (Hamilton, in 1954; Jackson, in 1957) and two in Georgia (Evans, in 1950; Treutlen, in 1955). Its spread through the Gulf States brings to mind two other introductions from southeastern Asia: *Digitaria violascens* Link (Gramineae) and *Perilla frutescens* (L). Britton (Labiatae). The former appeared first in Jasper Co., Texas, in 1932, and at scattered points farther east soon after. *Wahlenbergia marginata* seems to be making a more steady movement westward. *Perilla frutescens* is at a more advanced stage in geographic spread than either of the others. It is both a cultivated plant and a weed, and was reported as adventive as early as 1897 (Chapman, Fl. S. U.S., ed. 3, p. 390, as *P. ocymoides*). It is now widespread from eastern Texas and Oklahoma east to the Atlantic Coast, and north well into the Gray's Manual Range. Presumably its two fellow aliens will eventually occupy much of the same territory.—*Lloyd H. Shinners, Southern Methodist University, Dallas 5, Texas.*

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CONTENTS

Zoology

The Odonata of Oklahoma. *George H. Bick and Juanda C. Bick* 1

Notes on Mexican snakes (Ophidia). *William B. Davis and James R. Dixon* 19

Spring arrival of summer resident birds on the lower Rio Grande, New Mexico. *Harry C. Williams and Richard F. Johnston* 28

Vertebrates found in owl-pellets from northeaster Chihuahua. *Sydney Anderson and Philip W. Ogilvie* 33

Botany

Synopsis of the genus *Eustoma* (Gentianaceae). *Lloyd H. Shinners* 38

Note

Wahlenbergia marginata (Thunb.) A. DC. (Campanulaceae) in Louisiana. *Lloyd H. Shinners* . . 44